PRELIMINARY DIRECTIONS AND CONCEPTS

TOWARDS SUSTAINABLE TRANSPORTATION

DEVELOPMENT OF A REGIONAL TRANSPORTATION PLAN FOR THE GREATER TORONTO and HAMILTON AREA

MAY 2008

White Paper #2

METROLINX

LINKING PEOPLE TO PLACES • ON Y VA

A Message From the Chair

May 2008

Rob MacIsaac
Chair, Metrolinx

It is time for solutions.

With the release of two White Papers, Metrolinx is taking the next major step towards a plan to dramatically change and improve transportation choices across the Greater Toronto and Hamilton Area (GTHA).

The White Paper you are now reading sets out preliminary directions and concepts for a Regional Transportation Plan (RTP). These are potential initiatives to achieve the vision, goals and objectives set out in White Paper 1.

In the 16 months since Metrolinx was formed, we have undertaken a very broad, very detailed examination of transportation issues which affect this region. We released seven Green Papers to foster discussion around key topics.

We studied other jurisdictions to help determine best practices and learn about innovative projects.

We conducted extensive consultations with a wide range of stakeholders. And we have encouraged broad-based input both through our interactive website and through meetings with stakeholders.

All of this has given us a strong sense of direction together with some very specific ideas about how we might proceed.

You will notice as you read through White Paper 2 that each section outlines the things that could be done to improve transportation across this region. Based on the feedback we receive, we will then make decisions about what we believe should be done. Again, we will consult extensively, ultimately determining our recommendations for what will be done.

I urge you to keep an open mind as you consider the various proposals. In some cases, your first reaction, particularly to some of the bolder ideas, may be scepticism. The reality is, to achieve our objectives we need to think creatively. Yes, some approaches will be more challenging and controversial than others, but our decisions must not be based solely on ease of implementation.

Metrolinx will not be shy about recommending initiatives that are difficult, as long as we believe they will improve the quality of life for the six million people who rely on the region's transportation system, while enhancing our economic competitiveness and protecting our environment.

A Draft Regional Transportation Plan will be released for public and stakeholder consultation in late July. Our plan is to hold a series of Open Houses and Public Meetings across the region in September, giving everyone an opportunity to comment on every aspect of the Draft RTP.

Based on these consultations, and further discussions with the public on how the recommendations could be paid for and implemented, we will make the appropriate revisions and release the final RTP this Fall.

We will continue to welcome comments on our website and by other means throughout the process.

I am very excited about the progress we have made towards the specifics of the RTP. And I must say, this is long overdue. Decades ago, prior generations built subways, rail lines, and a grid of 400-series highways which supported prosperity for those who followed. It is our turn to step up to the plate.

We need to build a new transportation system using the principles of sustainability and complete mobility for those who will follow us.

Thank you for taking the time to read the White Papers. We look forward to hearing your thoughts, concerns and suggestions.

And we look forward to moving boldly ahead, creating a transportation system befitting a first-class city-region.

Rob MacIsaac
Chair, Metrolinx

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Executive Summary

White Paper 2 builds on the foundation of the seven Green Papers prepared earlier by Metrolinx and the responses received to them. It recognizes that a successful plan for a future transportation system is a combination of two key elements: i) ambitious policies and programs; and ii) well-integrated and functional infrastructure. Together they can create a bold, transformational transportation system.

This paper presents potential policy and program directions to address the issues identified in the Green Papers, and to fulfill the goals and objectives detailed in *White Paper 1: Vision, Goals and Objectives*. It also includes a preliminary analysis of the costs and benefits of four infrastructure system concepts. This paper is intended to generate further discussion and input to the process of creating a Regional Transportation Plan (RTP) for the *Greater Toronto and Hamilton Area (GTHA)*.

Preliminary Directions

The preliminary directions presented in this paper include policies, programs, regulatory tools and other measures that would facilitate a major shift in attitudes and choices related to mobility in the *GTHA*:

- A system of complete mobility through improved road and transit connectivity, strong *Transportation Demand Management (TDM)*, heightened attention to *active transportation* and seamless inter-regional and local service connections;
- A system of *mobility hubs* and other land use measures to ensure land use and transit service integration and the creation of a strong sense of place;
- Excellent customer service;
- Sustainable funding;
- Innovation through ongoing research; and
- Strong partnerships and effective decision-making.

Test Concepts

The paper also describes and analyzes four preliminary transportation system test concepts:

- **Business-As-Usual (BAU)** – The current transportation structure and committed transportation projects.
- **Test Concept A: Linear** – MoveOntario 2020 projects with some additions and enhancements to improve inter-regional connectivity.
- **Test Concept B: Radial** – Includes elements of the "Linear" concept, plus strengthens several major radial corridors from Union Station with lines providing very high levels of rail service.
- **Test Concept C: Web** – Includes "Linear" and "Radial" routes strengthened by additional east-west regional express connectivity.

In Appendix E, additional variations in road capacity are further tested against some of the concepts to assess the effect of road capacity on the performance of the overall system.

The four preliminary transportation system test concepts were modelled to determine their relative performance, and evaluated in the context of the vision, goals and objectives set out for the Regional Transportation Plan in White Paper 1. Among the preliminary results of the modelling exercise:

- Projected modal shares for transit and *active transportation* across the *GTHA* increase from the current 25.5 per cent to 32.5 per cent for Test Concept A, 36 per cent for Test Concept B, and 40 per cent for Test Concept C.
- Percentage of people, on average in the region, who live within walking distance of a *rapid transit* line increases from 11 per cent in 2006 to 25 per cent under Test Concept A, 30 per cent under Test Concept B, and 35 per cent under Test Concept C.

- Energy consumption for transportation decreases as each test concept increases investment in transit infrastructure, maintaining high levels of mobility in an energy-efficient manner. Under the BAU scenario energy consumption increases 22 per cent. Test Concept A yields energy consumption increases of 22 per cent, Test Concept B gives 18 per cent, and Test Concept C results in energy consumption of 16 per cent over current levels.
- As population increases, congestion costs are estimated to increase in the future from the current estimate of $2.2 billion per year, although these increases are significantly lower when transit investments are introduced. The BAU scenario results in congestion costs of $4.2 billion per year, whereas Test Concept A results in $3.1 billion per year, Test Concept B results in $2.7 billion per year, and Test Concept C results in $2.5 billion per year.

Two important caveats must be considered when interpreting the results of the modelling exercise. First, the model used in the preparation of this paper, like all models, has limitations. For example, it may underestimate the impacts of new modes and policies for which there is no observed behaviour from which to extrapolate. Also, it is not sensitive to changes in non-quantifiable measures, such as comfort, cleanliness and image of transit. Second, the preliminary transportation system test concepts are exactly that — concepts. They were developed and assessed merely to serve as a basis for discussion, review and comment by stakeholders and the public.

Preliminary Findings

Caveats notwithstanding, preliminary findings of the research-to-date include the following:

- Significant progress towards achieving the economic, social and environmental goals outlined in White Paper 1 can only be achieved through a combination of bold transit investment, coordinated transportation and land use planning, and supporting policies.
- Transit ridership increases are most significant when improved service is combined with aggressive land use intensification in transit corridors and at *mobility hubs*.
- The benefits in terms of transit use and efficiency are much greater when development is concentrated around a small number of *mobility hubs*, rather than when it is distributed over a more dispersed area.
- An *Express Rail* system would greatly enhance mobility for longer trips and is a viable new transportation option.
- *Metro* improvements (e.g. subway) should be considered in higher-density areas to maximize transit market share, as the transformative potential of *Light Rail* and *Bus Rapid Transit* is more limited.
- Feeder bus and *paratransit* fleets will need to double or quadruple in suburban areas to support the *rapid transit* network under any future scenario.
- Implementation of the transportation system test concepts outlined in this paper would not be sufficient by itself to meet provincial targets to reduce greenhouse gas (GHG) emissions. A whole suite of supporting programs and policies would be required. Further analysis will be performed to identify the steps and investments needed to meet these targets.

Implementing the Plan

This paper acknowledges the need for more reliable funding of transportation in the *GTHA*. It also outlines the need to better reflect the true costs of transportation choices and send appropriate price signals to travellers to encourage efficient use of the transportation system. Also acknowledged is the need for ongoing dialogue and partnerships across municipal and other administrative boundaries that involves well-informed citizens as full and active participants. Finally, the need for an ongoing program of research is identified to improve our understanding of transportation issues and the factors that will affect our region's success.

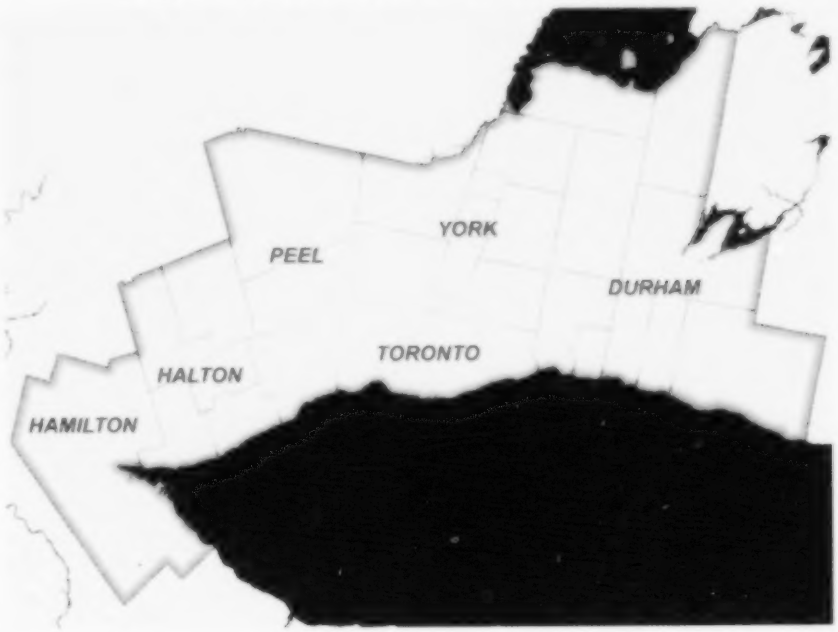
1 Background

1.1 The Metrolinx Mandate

Metrolinx was created by the Government of Ontario to develop and implement an integrated multi-modal transportation plan for the *Greater Toronto and Hamilton Area (GTHA)* — the metropolitan region encompassing the City of Toronto, the four surrounding regional municipalities (Durham, Halton, Peel and York) and the City of Hamilton. Its mandate includes providing seamless, coordinated transportation throughout this region, which is Canada's largest and among North America's most rapidly growing.

Metrolinx operates within the legislative framework of the *Greater Toronto Transportation Authority Act, 2006*.

Figure 1.1 The Greater Toronto and Hamilton Area



1.2 The Regional Transportation Plan

An immediate priority for Metrolinx is to create a Regional Transportation Plan (RTP), a long-term strategic plan for an integrated multi-modal regional transportation system. Triple bottom-line goals and objectives — people, environment, and economy — are guiding the RTP development, evaluation and recommendations.

The final RTP vision, goals and objectives for transportation in this region will assist decision-making in the day-to-day planning, coordination and implementation of the transportation system. The final RTP will set out priorities, policies and programs for a future of complete mobility. The plan will also be a touchstone by which we can monitor and regularly check to ensure that we are moving closer to the vision for a region that is supported by a high quality of life, prosperity and a healthy environment.

This region is rapidly changing and the rest of the world to which we are connected continues to change as well. Having a clear vision with specific goals and objectives that influence decisions is critical to a steady path forward.

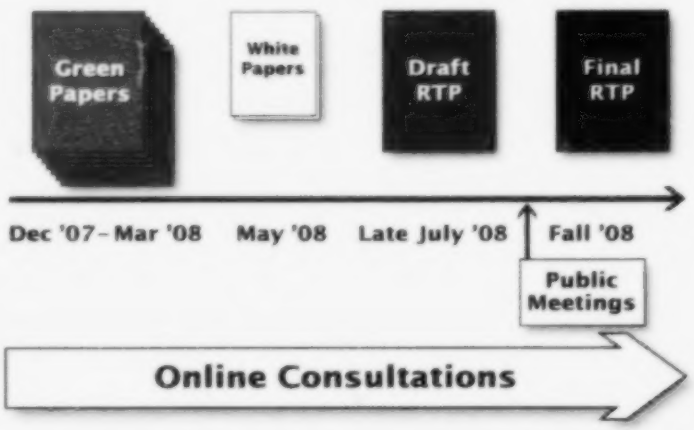
1.3 Developing the Regional Transportation Plan

During the period between December 2007 and March 2008, Metrolinx published seven Green Papers, as the first step towards developing the Regional Transportation Plan. These Green Papers presented key trends, challenges and opportunities for the *GTHA* transportation system for public discussion and showcased best practices from around the world.

A wide range of public comments has been received on the Green Papers, and this feedback has informed the development of two companion White Papers.

White Paper 1: Vision, Goals and Objectives presents the vision for the *GTHA* transportation system, and a series of goals and objectives which, along with a range of possible indicators, form the basis for developing, evaluating and ultimately shaping the RTP.

Figure 1.2 The RTP Consultation and Development Process



White Paper 2: Preliminary Directions and Concepts draws together the two key aspects of the plan: transformational policy programs and tools; and well-integrated and functional infrastructure. The paper sets out a preliminary analysis of several test concepts including a Business-As-Usual (BAU) concept for the transportation infrastructure system for a preliminary performance/cost comparison.

The White Papers have been published as interim reports to provide a basis for ongoing consultations with stakeholders and the public. Input on the White Papers will help to inform the development of the Draft RTP that will be released in conjunction with a Draft Investment Strategy for public comment and broad consultation in late July. The Investment Strategy will set out a suite of potential dedicated revenue sources and funding tools to expand, maintain and operate the regional transportation system in a financially sustainable way over the next 25 years and beyond.

The final Regional Transportation Plan will be released in Fall 2008.

1.4 Purpose and Structure of This Paper

White Paper 2 presents potential programs and policies to address the issues identified in the Green Papers, and fulfil the goals and objectives listed in White Paper 1. It also analyzes several transportation system test concepts for the year 2031. Ultimately, the RTP will identify a complete package of programs, policies, potential legislative changes and infrastructure proposals, that when implemented together, would create a bold, transformational transportation system. These pieces must work together to provide an improved experience within the transportation system, encourage a significant change in travel behaviour, and deliver a robust and convenient transportation network.

The following Green Papers are available for review and comment at www.metrolinx.com or by calling 416-874-5900.

- **Green Paper 1: Towards Sustainable Transportation (December 2007)**
- **Green Paper 2: Mobility Hubs (February 2008)**
- **Green Paper 3: Active Transportation (February 2008)**
- **Green Paper 4: Transportation Demand Management (February 2008)**
- **Green Paper 5: Moving Goods and Delivering Services (February 2008)**
- **Green Paper 6: Roads and Highways (March 2008)**
- **Green Paper 7: Transit (March 2008)**

The proposed directions create an environment that facilitates a major shift in attitudes and choices related to the transportation system. They include educational and promotional programs, a comprehensive regional parking strategy, convenient transit fare payment, and planning for improved integration between transportation, and office and residential developments.

White Paper 2 also analyzes several test concepts of infrastructure improvements. These concepts support the objectives of the *Growth Plan for the Greater Golden Horseshoe, 2006* and are based on MoveOntario 2020, local Official Plans and transportation plans. The test concepts are described in Section 3.

A preliminary analysis of the test concepts presents some initial findings and conclusions, based on estimated cost and network performance improvements under year 2031 conditions. The findings are described against the key goals and objectives identified in White Paper 1.

This report also discusses implementation activities and issues, including necessary coordination activities and collaborations. A summary of next steps is presented, which focuses on ongoing work and input leading to the development and continued evaluation of the pieces that will be presented in the Draft RTP.

Definitions for the italicized terms found in this paper are provided in the Glossary of Terms found in Appendix A.

1.5 Current and Future Challenges

As described in Green Paper 1, transportation supply and demand and performance trends over the past two decades have been deteriorating. A projection of these trends to the year 2031 shows continuing decline unless significant improvements are made.

In the Green Papers, these trends and challenges were explored in detail and some key conclusions emerged.

- Our system for planning and financing transportation and our individual travel behaviours are unsustainable.
- The transportation system must be improved to meet the needs of current residents, and also the millions more who will call this region their home in the future. Our population and employment forecasts show an increase of 2.5 million people and 1.3 million jobs across the *GTHA* by the year 2031, which will place increasing demands on our transportation system.
- Existing infrastructure is being used inefficiently, with far too many trips being taken in single-occupant motor vehicles and far too few trips being taken by transit, bicycle or foot. Average automobile occupancy rates are only 1.2 persons/vehicle.
- There is little choice for travellers. Most feel they need to depend on cars for getting around, or are limited by how far they are able to walk or how well their neighbourhood is served by transit. The average percentage of trips taken by car across the *GTHA* is currently 75 per cent.
- Transportation infrastructure and operations require predictable and reliable revenue sources. Funding for transportation infrastructure has not kept pace with the needs of a growing population, thereby reducing our productivity and increasing the cost of our goods and services.
- The true cost of travel is not reflected in the prices that users pay for different options.
- The cost of operating an automobile in the region will continue to rise as a result of increasing fuel, insurance and other associated operating costs.
- There is a lack of awareness of the impacts of individual travel behaviour.
- The system is out of balance and in many instances seems designed for cars instead of people. Priority is generally given to car travel over other means, such as transit or *active transportation*.
- Land use planning and transportation planning are not being well-integrated. Low-density land use patterns, particularly in the suburban areas of the region, do not adequately support the provision of improved, competitive transit service.
- The transportation system is not adequately integrated and coordinated across boundaries, or across modes.
- *Transportation Demand Management* (TDM) and *Intelligent Transportation Systems* (ITS) efforts are under-funded and therefore not used to their potential across the *GTHA*. Current efforts are not coordinated or integrated to maximize their effectiveness.
- More emphasis and resources are required to improve overall transit customer service (e.g. vehicle cleanliness, personal safety, real-time travel updates, etc.).

In order to be transformational, the RTP must address these challenges with a broad range of tools; improvements to infrastructure alone will not be sufficient. Changes to legislation, educational and promotional programs, and supportive policies must also be designed and implemented. These pieces must work together to provide an improved experience within the transportation system, encourage a significant change in travel behaviour, and deliver a robust and convenient transportation network.

A Strong Foundation

Some important and foundational work is already in place, making the way forward promising. The province of Ontario and municipalities are implementing the *Growth Plan for the Greater Golden Horseshoe* that will direct growth in a way that makes transit and *active transportation* increasingly viable options. The Greenbelt Plan protects rural, natural and agricultural areas that are important to the ecological health of the region. In addition, all levels of government are recognizing the importance of programs, policies and legislation which create an environment that promotes more sustainable practices in travel behaviour.

The RTP will build on this work, marking the beginning of a journey towards a vastly improved, more sustainable transportation system. We have little choice but to change. Our current transportation system is quickly becoming dysfunctional. Space and cost considerations limit our ability to increase the capacity of major highways and *arterial roads*. We need to rely more on transit and *active transportation*. This means transforming land use, road use, goods movement and demand management policies. It means a bold plan and financial commitment to infrastructure over the long-term. It means a changed culture and behavioural shifts to address how we get around the region. This plan will be a guide to a future that offers complete mobility. It will set the foundation for a sustainable transportation system and more sustainable communities. This plan will be key for the *GTHA* to become one of the world's most attractive and successful regions.

Have a Say! Help Shape the GTHA's Transportation Future

Whether we walk to the corner store, take transit to work, drive to the hospital, cycle to school, or rely on the movement of goods for our business, we all have opinions about how the GTHA's transportation system is performing. Many of us have thoughts on how it could be improved. Whatever your transportation situation, Metrolinx wants to hear from you as we develop the Regional Transportation Plan for the GTHA. The more people we hear from, the more inclusive and effective the Plan will be.

Visit www.metrolinx.com to participate in our online public consultations or contact us at 416-874-5900 to find out how you can get involved.

2 Preliminary Directions

Meeting the ambitious goals and objectives set out in White Paper 1 for the RTP means not only building a new, bold transportation system, but also putting in place a comprehensive suite of smart, up-to-date, and innovative programs and policies.

In this section, we present, for discussion, a series of preliminary directions that could be undertaken to achieve the proposed vision, goals and objectives. These will be necessary to realize the full potential of a new and expanded transportation system. These directions have been based on the content and feedback received on the Green Papers.

The preliminary directions presented here are wide-ranging.

Some are major, multi-million dollar efforts; others are smaller things that cumulatively could make a big difference.

Some would take many years to implement; others could be accomplished right away.

Some of these preliminary directions would be the responsibility of governments at the federal, provincial or municipal levels. Some could be led by Metrolinx. Others could be led by non-governmental organizations, private sector businesses, schools, individuals and others. Many will be the shared responsibility of more than one entity.

The preliminary directions include policies, programs, best practices, legislation, regulations and incentives.

All of these preliminary directions are presented here for feedback and discussion. We want to hear your ideas.

- Which directions should receive the highest priority?
- Do any directions require clarification?
- Are there any missing directions?
- Who should take the lead on each of the directions?

The preliminary directions are summarized into the following categories:

What we want to achieve:

- A System for Complete Mobility
- Placemaking and *Mobility Hubs*
- Excellent Customer Service

What needs to be done to get there:

- Sustainable Financing
- Innovation though Research
- Partnerships and Clear Decision-Making

(Note: technical terms that have been italicized are defined in the Glossary of Terms found in Appendix A).

2.1 A System For Complete Mobility

This set of preliminary directions is intended to expand the existing transportation network into a complete and integrated transportation system. A complete transportation system will offer users more choices, reduce impacts on the environment and help ensure the region's continued competitiveness and prosperity. Many of the preliminary directions for complete

mobility will be closely linked with the Investment Strategy, which will address reliable, long-term funding being made available from a variety of public and private sources for the expansion, renewal and operation of the region's transportation networks.

Direction 1: Improve travellers' options and encourage responsible choices by establishing a *transportation hierarchy* to be used as the basis for planning, designing, financing and operating the transportation network and for land use planning, based on the following:

i. *Transportation Demand Management (TDM)*
ii. *Active transportation*
iii. Transit
iv. Carpooling, car-sharing and taxis
v. Single-occupant vehicles

Direction 2: Optimize the efficiency of the transportation system through an ambitious *Transportation Demand Management (TDM)* program.

Possible Options:

i. Following the lead of many of the region's municipalities and employers, encourage or require all governments, provincially funded agencies, such as school boards and hospitals, *major trip generators*, and major new residential and commercial developments to implement *TDM* programs.
ii. Support the Smart Commute initiative and encourage the creation of Transportation Management Associations.
iii. Develop guidelines to help municipalities develop and implement *TDM* policies in their Official Plans, as required by the *Growth Plan for the Greater Golden Horseshoe*.

TDM programs could include...

- Identifying a staff person as a *TDM* coordinator to develop and help implement *TDM* programs, as many municipalities and institutions have already done.
- Making an emergency ride home service available to employees.
- Developing policies to promote telework opportunities and flexible work hours.
- Supporting Active & Safe Routes to School programs to encourage students to walk or cycle to school.
- Encouraging provincial and municipal governments and agencies to lead by example.

Direction 3: Promote *active transportation.*

Possible Options:

i. Support and coordinate the work of municipalities across the region to plan and implement comprehensive walking and cycling networks. Undertake *active transportation* audits in municipalities to identify gaps and deficiencies, and prioritize improvements.
ii. Install bike racks on all buses and amend both the *Highway Traffic Act* (Section 109) and the *Public Vehicles Act* (Sections 23 and 24) so that buses with bike racks would not require special permits.
iii. Create a pilot bike-sharing program in a major urban centre modelled after the Vélib' program in Paris, France.
iv. Establish *active transportation modal split* targets for all *urban growth centres*, *mobility hubs*, and *major trip generators*, including schools and universities.

Other measures to support active transportation could include...

- Amenities for cyclists and pedestrians such as showers, change rooms and bike storage in large office and commercial buildings, and major *mobility hubs*.
- Snow-clearing standards that focus on the needs of pedestrians and cyclists.
- Designing and locating parking and drop-off areas around schools in a manner that ensures priority access and safety for students who arrive by walking or cycling.
- A region-wide bicycle registry with the ability to report and look up stolen bikes.
- Extension of the provincial sales tax exemption for bicycles and related safety equipment.
- Considering opportunities for promoting *active transportation* and connecting key destinations when designing greenways strategies and park systems.
- Pedestrian and cyclist bridges at key locations crossing 400-series highways.
- *"Queue-jump" lanes* for cyclists at key intersections.

Direction 4: Build a comprehensive regional transit network that provides new services and enhances existing services.

Possible Options:

i. Enhanced *rapid transit* service in east-west corridors across the region, including between suburban communities.
ii. High-order connectivity to Pearson Airport from all directions, including a high-speed transit link to downtown Toronto.
iii. Seamless connectivity across municipal boundaries, such as eliminating restrictions for transit operators to pick up passengers while passing through neighbouring jurisdictions.
iv. On-demand transit to and from GO Transit stations.
v. Connectivity between places and along corridors that support the urban structure and intensification objectives of the Growth Plan.
vi. Better linkages between socially disadvantaged areas of the region and the transportation network.
vii. Improved access by non-auto-based transportation modes to major transit stations such as GO Transit stations.

Direction 5: Support the regional transit network with robust, comprehensive and coordinated local transit networks.

Over time, update local Transportation Master Plans to align with the Regional Transportation Plan.

Direction 6: Improve options for, and reliability of, goods movement.

Possible Options:

i. Develop a strategy with incentives to steer a portion of inter-regional goods movement traffic away from congested times and areas on roads and highways.
ii. Improve goods movement infrastructure through rail service rationalization and better road infrastructure to and from large inter-modal facilities.
iii. Reserve lands near major transportation infrastructure, such as inter-modal facilities and highway interchanges, for goods-intensive land uses.
iv. Develop separate land use categories in Official Plans and Zoning By-laws for goods movement-intensive land uses, and develop policies to ensure that these areas are able to move goods quickly and efficiently, while minimizing the demands on the transportation system.

v. Plan and design new *controlled-access highways* to give priority to goods movement, through measures such as the location and spacing of interchanges, permitted land uses around interchanges, and prioritizing those highways that connect key goods movement hubs and major freight, logistics and inter-modal facilities.

vi. Ensure coordination with other planning efforts to improve efficiency and reliability of goods movement to and from the U.S. borders.

Other measures to support goods movement could include...

- Priority measures for truck-based goods movement for long-distance east-west through-trips.
- A new east-west dedicated rail freight corridor.
- Freight impact studies for new manufacturing, warehousing and industrial developments that examine ways to minimize impacts on the transportation system, particularly during peak hours.
- Common standards for municipalities to identify local truck routes.
- Encouraging local food production and processing to reduce the need for long-range transport.

Direction 7: Develop a long-range land protection and/or acquisition strategy to accommodate future needs for *active transportation*, transit, roads, highways and goods movement.

Possible Options:

i. Determine future transportation network expansion needs, including likely long-range requirements beyond the planning horizon of the RTP, and acquire or otherwise act to protect land for future transportation corridors and *mobility hubs*.

ii. Protect existing transportation corridors including existing or abandoned rail rights-of-way and hydro corridors for use as future network links.

iii. Establish protocols with the Ontario Realty Corporation to facilitate the use of provincially owned lands for transit facilities.

Direction 8: Design and operate roads to better support all modes of transportation.

Possible Options:

i. Design roads so that they do not compete with existing or planned transit, particularly when the transit service operates within the same corridor.

ii. Progressively retrofit existing and new arterials that have six or more lanes of traffic with *High Occupancy Vehicle* (*HOV*) / transit lanes through conversion of existing lanes.

iii. Design *HOV* lanes to optimize transit use, through measures such as simplifying the process of entering and exiting lanes or providing separate *HOV* lane on- and off-ramps.

iv. Improve connections to *mobility hubs*.

Many municipalities have employed one or more of the following measures to support walking and cycling...

- Traffic calming at key pedestrian and cyclist destinations such as schools, local retail stores, *mobility hubs* and community centres.
- Landscaping and other amenities, such as street furniture and lighting that enhance the experience of *active transportation* users.
- Narrowing of streets in high-pedestrian traffic areas.
- Phase-out or redesign of channelized right-turn-only lanes.
- Audio signals at major signalized pedestrian crossings.
- Resting points and island refuges on wide crossings.

Streets could give priority to transit with measures such as...

- "Signal priority" devices that allow transit vehicles to change traffic signals at key intersections as they approach.
- *"Queue-jump" lanes* that allow transit vehicles to bypass other traffic at key intersections.
- Parking and turning restrictions for cars.

Direction 9: Reduce traffic congestion and delays by implementing improved incident-clearing procedures.

Possible Options:

i. Develop joint training and operational protocols and performance standards for transportation and emergency service agencies on highway clearing.
ii. Continue to investigate ways to improve the ability of emergency service providers to clear vehicles and debris quickly from highways and roads, without fear of liability issues.
iii. Expand and integrate incident detection systems.
iv. In coordination with the insurance industry, implement measures and protocols to minimize disruption to rail transit due to incidents at grade crossings.

Direction 10: Create new markets for transit.

Possible Options:

i. Alternative service models for suburban and rural communities, including outsourcing and smaller vehicles to provide more service in off-peak hours. Examples could include smaller off-peak trains, jitneys, shuttle bus services, and dial-a-bus to and from key destinations.
ii. Augment public transit ridership in low ridership areas by initiating U-PASS programs with local school boards, shifting high school students from yellow buses to transit buses, and encouraging the development of a flexible, multi-purpose public transportation system with a variety of vehicles.
iii. Amend the Ontario *Public Vehicles Act* to allow employers, *major trip generators*, tourism destinations and other third-party operators to implement vanpooling.

Other measures to attract new users to transit could include...

- GO Transit train excursion packages to key regional tourism destinations.
- Free or reduced transit fares on smog days.
- Discounted weekend fares with free access for children.
- Free or discounted transit day-passes provided by event organizers and tourism partners, such as hotels.

Direction 11: Promote ride-sharing and car-sharing.

Possible Options:

i. Parking for car-sharing vehicles reserved in all large parking lots.
ii. The existing provincial carpool lot network expanded to include additional lots at strategic locations, aligned with the *HOV* and *Bus Rapid Transit* (*BRT*) networks, particularly at the periphery of the region.
iii. Taxi stands included at all *mobility hubs*.
iv. Post information about carpooling at all parking lots beyond a certain size.

2.2 Placemaking and Mobility Hubs

For any transportation system to be successful, it needs to be supported by an appropriate and attractive urban form and structure. Whether you are commuting to work, taking your child to school, or running an errand, how your neighbourhood has been planned will influence how you travel.

The *Growth Plan for the Greater Golden Horseshoe* establishes a regional land use structure for the *GTHA* that focuses growth in existing urban areas, around key nodes such as downtowns and *major transit station areas*, and along corridors such as *arterial roads*. It calls for the creation of more complete and compact communities, that are pedestrian- and transit-friendly.

In this section, we present a range of directions that would comply with the Growth Plan, and ensure that the transportation system is supported by appropriate land uses.

Direction 1: Build complete communities that are pedestrian, cycling and transit-supportive.

Possible Options:

i. Adopt planning policies and targets in Official Plans that support and reinforce the directions in the Growth Plan to create pedestrian-, cycling-, and transit-friendly communities.
ii. Focus growth in nodes and along key corridors such as *arterial roads* that would support the efficient delivery of transit service.
iii. School catchment areas defined on the basis of maximizing walking and cycling as the primary means of school travel.
iv. New institutions such as elementary, secondary and post-secondary schools, regional hospitals, large sporting venues and cultural centres leading by example by demonstrating excellence in transit-oriented and pedestrian-friendly design.

Transit-, cycling- and pedestrian-supportive measures could include...

- Designing new subdivisions such that all homes are within walking distance of a transit stop with frequent service.
- Identifying the locations of transit stops in new developments as part of the planning approval process.
- Erecting transit stop signage as soon as roads are constructed in new developments so that prospective homebuyers are aware of the planned location of all stops.
- Establishing sidewalks on both sides of all streets.
- Creating an attractive and pleasant walking and cycling environment, through measures such as attractive landscaping, shade trees and public art.

Direction 2: Identify a system of *mobility hubs* for the *GTHA*.

A system of existing and planned *mobility hubs* could be identified for the region based on strategic location, planned transit service level, transit-oriented development potential and that complements the *urban growth centre* structure of the Growth Plan.

A suite of programs and policies could be developed that is appropriate to each hub type. Four hub types have been identified for consideration:

i. **Anchor hubs** would be strategically located hubs with the highest level of planned transit service, combined with significant transit-oriented development potential within their *transit catchment areas*. These hubs would encompass current or planned major regional destinations such as major institutions, employment centres, town centres, regional shopping centres, etc.

ii. **Gateway hubs** would be hubs located at major regional transit interchange stations, with high levels of planned transit service, but lacking the significant transit-oriented development potential of anchor hubs. These hubs would be current or planned gateways between regional *higher-order transit* lines and destinations.

iii. **Destination hubs** would be hubs located at unique destinations that have significant drawing power (e.g. universities, regional shopping centres, hospitals, tourism destinations, etc.). These hubs may or may not have existing *higher-order transit* or transit-oriented development potential, but are important regional activity centres and *major trip generators*.

iv. **Higher-order station hubs** would include all other stations on *higher-order transit* lines not included in the previous definitions, that are locally significant gateways to the transportation system.

Direction 3: Identify and incorporate *mobility hubs* into planning policy documents including Official Plans and Transportation Master Plans.

The location, type and function of *mobility hubs* could be identified in all Official Plans and Transportation Master Plans. This planning framework could:

i. Identify *mobility hubs* as priorities for higher-density development and a mix of uses, with a strong emphasis on *major trip generators*.

ii. Set minimum densities for population and employment for *mobility hubs*, consistent with the type and function of the hub, and in compliance with the Growth Plan.

iii. Set target *modal splits* for *mobility hubs*.

iv. Identify *mobility hubs* as *major transit station areas* as defined in the Growth Plan.

v. Encourage cultural facilities, public institutions, public service buildings and civic buildings to locate in *mobility hubs*, wherever feasible.

vi. Establish a range of appropriate uses that complements the purpose and function of the *mobility hub*.

vii. Establish a parking reduction strategy for *mobility hubs*.
viii. Identify *mobility hubs* as potential tax increment financing districts or community improvement plan areas to allow for fiscal and other incentives for development including value-capture strategies, area development charges/assistance, public-private partnerships, and expropriation powers.

Direction 4: Prepare *mobility hub* master plans.

Municipalities could work with transit operators and landowners to prepare master plans for *mobility hubs*. These master plans could:

i. Set clear policies for enhancing transit, pedestrian and bicycle access.
ii. Identify optimal zoning standards that ensure appropriate development that maximizes the return on the transit investment.
iii. Provide for customer service amenities such as clean, comfortable, weather-protected waiting areas, and a plentiful supply of areas for waiting.
iv. Establish a pedestrian-focussed internal movement plan that stresses efficient, comfortable movement through a well-designed human-scaled place.
v. Identify how transit can be introduced to and integrated into the site.
vi. Provide access for users with special needs.
vii. Accommodate direct connections to the *transit catchment area*, and provide shortcuts and minimize barriers and detours for transit, walking and cycling.
viii. Establish policies to phase-out free parking and replace it with enhanced access for transit, cycling and walking.
ix. Set aside reserved parking spaces for carpool and car-sharing vehicles.
x. Provide secure, weather-protected bicycle storage facilities.
xi. Achieve at minimum *LEED* Gold or equivalent standards for building design.
xii. Improve the travelling experience through the use of public art, landscaping and architectural excellence.
xiii. Set high standards for safety and cleanliness.
xiv. Provide some degree of flexibility for technology shifts through more modular and scalable design elements.

Direction 5: Enhance the roles of Union Station and Pearson Airport precincts as the *GTHA*'s largest and most unique *mobility hubs*, with convenient transfers between local/regional transit/transportation, inter-city rail and bus services, and active modes of transportation.

Pearson Airport and Union Station are two places in the region where inter-modal activity can be expected to grow substantially over the next 25 years. Both areas demonstrate core anchor hub qualities but with unique significance on a national and international scale. Distinct policies, programs and tools could be developed for these two hubs, beyond those described for other *mobility hubs* in this section of this paper.

Direction 6: Develop comprehensive parking strategies.

As alternatives to driving are introduced, planning and financial mechanisms could be used to redesign and reduce parking areas in order to support the creation of pedestrian-, cycling-, and transit-friendly communities and promote the use of alternatives to the automobile.

Possible Options:

i. Update municipal parking by-laws regularly, with increasing emphasis on lowering parking requirements.
ii. Offer developers the option of providing other benefits in lieu of parking, such as transit passes, car-sharing memberships, carpooling services, reward points toward services and products, or cash contributions towards transit or *active transportation* infrastructure.

Some of the best practices that have been used by GTHA municipalities to reduce and redesign parking areas include...

- Allowing off-site, on-street and shared-parking capacity to be counted towards meeting minimum parking requirements.
- Requiring parking management plans for new developments.
- Establishing minimum bicycle parking requirements for new residential and commercial buildings over a certain minimum size.
- Establishing parking design guidelines that ensure parking facilities do not act as barriers to *active transportation*.

Direction 7: Plan, design and build the transportation system in a way that directs growth towards existing urban areas, and away from natural areas and agricultural lands.

2.3 Excellent Customer Service

In addition to increasing the range of transportation options that are available to people, a high-quality transportation system needs to provide a safe and enjoyable travelling experience. The transportation system must put the needs of users first, and travellers must be given the information they need to determine whether, when, where and how they travel. In this section, we present a series of directions designed to improve customer service.

Direction 1: Create an online regional transportation information system.

Possible Options:

i. A regional transportation information portal that is accessible online and by telephone, e-mail or PDA that provides travellers with easily accessible, centralized information on the full-range of transportation alternatives available to them.
ii. Real-time information available to transit riders at key transit stops and by e-mail or web that informs them of the arrival time of the next transit vehicle.
iii. Expanded use of display boards on roads and highways to show the estimated time to key destinations and notify travellers of delays.
iv. Display boards at transit stations and around urban cores to show availability and location of parking spaces.

An online regional transportation information portal could provide information on...

- Transit schedules.
- Real-time location and arrival time of transit vehicles.
- Regional transportation maps and guides (including roads, transit, trails, lanes, paths, cycling routes).
- Road and transit closures, construction and detours.
- Planned infrastructure improvements.
- School bus cancellations.
- Parking lot location and availability.
- Fares.
- Carpooling.
- Car-sharing.
- Cycling facilities (e.g. storage facilities, maintenance facilities).
- Air quality conditions/smog alerts.
- A personal carbon-footprint calculator that allows people to compare the environmental impacts of their transportation choices.
- Opportunities for contributing to local carbon offset programs.
- Air quality index values to inform people when air quality is low, and that transit use is encouraged.

Direction 2: Provide a seamless transit/transportation experience.

Regional travel could be made more convenient and barrier-free as travellers transfer between modes and services, and cross regional boundaries.

Possible Options:

i. Coordinate schedules among transit service providers, including demand-responsive services for persons with disabilities.
ii. Require GO Transit and local transit service operators to provide each other with a minimum 90-days' notice before implementing any changes in service, to allow time for operators to adjust and coordinate their schedules.
iii. Adopt protocols to coordinate response, mutual assistance and information-sharing among transit operators, in the case of delays and other exceptions.
iv. Integrated customer service that allows users to obtain travel information about the entire system from any service provider.

A common set of procedures, and visual and audio cues can help make the transit system easier to use and navigate...

- Consistent numbering and naming of transit stations and stops.
- Common transit signage standards.
- Next-stop announcements on transit vehicles.
- Convenient and user-friendly facilities, signs and services for travellers.
- Common region-wide branding of transit.

Direction 3: Foster a new "transit lifestyle" by simplifying the payment of transit fares and rewarding regular users.

Possible Options:

i. Implement, as soon as possible, the Presto fare smart card that allows users to pay a seamless, integrated fare for all transit systems across the region.
ii. Expand the use of U-PASS programs currently offered by many transit providers to include all post-secondary and high school students, as well as major employers.

The Presto fare smart card could provide many additional benefits...

- Provincial and municipal governments could use the card for multi-application service delivery (e.g. parking, library card).
- Partnerships could be established to turn Presto into an electronic wallet, debit and credit card.
- Frequent users could be offered loyalty reward benefits.
- Local retailers or event operators could offer discounts to card holders.
- Presto reward points could be offered in the event of delays or cancellations.

Direction 4: Establish region-wide *transit service standards*.

Region-wide standards for customer service could be developed and adopted for all transit operators, and operators could be required to develop a strategy to meet these standards and to report publicly on their performance. Standards could address issues such as maximum service *headways*, loading and crowding, service reliability including delays and cancellations, cleanliness and comfort, and customer satisfaction.

Direction 5: Improve access for seniors, persons with disabilities and others with special needs.

Possible Options:

i. Establish service guarantees for specialized transit.
ii. Coordinate specialized transit services on a regional basis, with the possibility of merging services.
iii. An adapted, diverse fleet of transit vehicles across the region that is in conformity with *Accessibility for Ontarians with Disabilities Act* (AODA) standards.
iv. Accelerate the achievement of AODA conformity in transit facilities, such as stop announcements and station access.
v. Free companion transit passes for people who accompany individuals who require assistance.
vi. Ensure ongoing training for transit operators to ensure they have an understanding of, and are sensitive to, the needs of persons with special needs.

Direction 6: Provide marketing and promotional material on transportation alternatives directly to individual commuters, households and employers.

Possible Options:

i. Individualized social marketing campaigns directed at the household level to reach every household at least once every three years with information about transportation alternatives, including local transit routes and schedules.
ii. Build on the success that many *GTHA* municipalities have had with producing cycling and pedestrians route maps by creating maps for all municipalities in the region.

iii. A comprehensive, *GTHA*-wide *active transportation* promotional campaign, in partnership with public health groups.
iv. Encourage developers to provide information about transportation alternatives, including local transit routes and schedules, to new home buyers.
v. Transit routes, schedules and fare information available at all transit stations.
vi. Require operators of non-residential parking lots to provide easily visible information on carpooling, such as links to online carpooling or ride-matching services.

Direction 7: Improve safety of all modes.

Possible Options:

i. Training and educational programs to increase the safety awareness of drivers, cyclists and pedestrians.
ii. Multi-user safety audits of *mobility hubs*, transit stations and roads/intersections to identify and modify "trouble spots."
iii. Wider use of *Crime Prevention through Environmental Design*, including measures such as designated parking areas, designated waiting areas, night-time on-request stopping, clear sightlines, higher lighting levels at transit stops and stations, and emergency telephones and buttons.

Additional safety enhancement measures could include...

- Safety sideguards on trucks to protect cyclists.
- Automated enforcement technology for speeding and red lights.
- Reduced speed limits in high-pedestrian traffic areas and around schools.

2.4 Sustainable Financing

A lack of sufficient and dependable financing has been a major impediment to ongoing investments in transportation across the *GTHA* over the past few decades. New revenue sources are needed. At the same time, we need to better reflect the true costs of transportation choices and send appropriate price signals to travellers to encourage efficient use of the transportation system. Costs have to be distributed in such a way that one transportation mode is not unfairly subsidizing another. These issues will be explored more fully in Metrolinx's Investment Strategy; however, a preliminary set of potential directions is presented here.

In addition to developing the Regional Transportation Plan, Metrolinx will develop an Investment Strategy to identify potential financial tools and revenue sources for the initiatives and priorities set out in the Plan. All options will be considered, including government funding, private sector investment, user-fees such as parking fees, road pricing or tolling, and transit fares.

As a sustainable financing plan, the strategy will include a life-cycle approach to expansion, optimization, renewal and operations. Its aim will be to suggest sufficient, reliable and dedicated funding sources to turn the Regional Transportation Plan into a reality.

Direction 1: Better reflect the true cost of using the road system as a way of promoting more responsible transportation choices.

Possible Options:

i. User fees for roads, such as road tolling.
ii. Vehicle registration fees, charged based on time-of-day, distance travelled, and/or geography, which could be increased for fuel-inefficient vehicles and decreased for fuel-efficient, low-emission vehicles.
iii. Transit fares varied by time-of-day, distance travelled and/or geography.

Direction 2: Re-invest revenues generated from transportation-related user-fees to fund transportation infrastructure and programs.

Revenues generated from transportation-related user-fees could be re-invested to fund transportation infrastructure and programs that align with the RTP. Metrolinx could, for example, coordinate and administer the collection and distribution of these revenues, and front-end transportation investment by floating bond issues based on the generated revenue streams.

Direction 3: Eliminate free and subsidized parking.

Possible Options:

i. Recognize free or subsidized parking provided by employers as a taxable benefit, even for the provision of non-reserved spaces.
ii. Charge for parking at transit stations separately from transit fares.
iii. Recover 100 per cent of capital and operating costs from parking fees for parking facilities at public facilities, including transit stations.
iv. Property taxation and other financial strategies to increase the cost of parking, particularly surface parking, and encourage more efficient parking provision.
v. Encourage employers to offer their employees a choice between a free or subsidized parking space and a cash equivalent.
vi. Encourage developers and building managers to sell or lease parking spaces separately from residential or commercial space.

Direction 4: Provide financial incentives to promote transit use.

Possible Options:

i. Remove the taxable benefit status for employer-provided or employer-subsidized transit passes.
ii. Expand the practice of many transit operators to offer bulk transit pass sales to employers and *major trip generators*.
iii. Reward car owners for taking older vehicles out of service with measures such as tax incentives and/or the provision of a transit pass for one year.

Direction 5: Ensure that new development pays its fair share of costs for all modes of transportation.

Possible Options:

i. Amend the *Development Charges Act* to enable municipalities to levy charges for all transportation-related infrastructure, including pedestrian and cycling facilities.

ii. Amend the *Development Charges Act* to allow municipalities to recover the full growth-related cost of transit infrastructure, and to base cost recovery on a level of transit service above existing levels.

iii. Encourage or require developers to temporarily subsidize transit service to their developments wherever an appropriate cost recovery ratio would not otherwise be met, for example by providing free transit passes for a period of one or two years after project completion, or until a pre-determined ridership level is reached.

Direction 6: Leverage private sector resources to help deliver transportation improvements while ensuring ongoing public control.

As a prerequisite for funding, the evaluation of the feasibility and desirability of Alternative Financing and Procurement (AFP) strategies could be required as a means to expedite the delivery of transportation infrastructure, design, construction, maintenance and/or operations, and to ensure the most appropriate allocation of both private and public sector resources.

Direction 7: Develop and apply mechanisms to capture increases in land values that result from new transportation infrastructure as a revenue source to finance the transportation investment.

2.5 Innovation Through Research

The best transportation systems and transportation plans are informed by the best available data and research. In the *GTHA*, information gaps exist in several areas, particularly with regard to the movement of goods and delivery of services. As the Regional Transportation Plan is being implemented, it will be important to continue to improve our understanding of transportation issues, and the factors which affect our success. The RTP will propose some innovative new programs which have proven to be successful around the world, but where our local knowledge and experience may be lacking. There will be a need to build on existing local expertise through demonstration projects and best practices. In this section, opportunities for ensuring ongoing innovation through research are identified.

Direction 1: Improve our understanding of goods movement.

Possible Options:

i. Develop a database for information-sharing among private and public sector goods movement entities.

ii. Provide funding and develop regulations to further disseminate available technology, such as loading and route optimization, and Global Positioning Systems (GPS).

iii. Pilot innovative approaches, such as the use of *light rail transit* systems for urban deliveries, centralized lockboxes for end-consumer deliveries, shared urban freight and delivery centres (e.g. for construction sites) and logistics villages (e.g. next to inter-modal hubs).

Better information sharing on goods movement could lead to...

- A regional strategy for the planning of large-scale logistics, inter-modal and other goods movement facilities.
- Identification of load consolidation opportunities.
- Strategies to reduce GHG emissions from goods movement.
- Systems and standards to easily understand, calculate and communicate the cost and emissions impacts of shipping choices, both to shippers and end-consumers.

Direction 2: Identify and eliminate barriers to *short sea shipping*.

Identify barriers to *short sea shipping* on the Great Lakes in partnership with other jurisdictions, and investigate new opportunities, such as transferring containers from larger ships downstream to smaller ships for direct deliveries to Great Lakes ports on either side of the border.

Direction 3: Develop Centres of Expertise on the relationship between land use and transportation.

Possible Options:

i. Centres of Expertise to undertake research, promote best practices, and provide advice and technical assistance with respect to *mobility hub* design, street design and parking management.
ii. An urban development agency to lead development around those *mobility hubs* where jurisdictional issues, land ownership patterns, or other issues present particular challenges.

Direction 4: Build a better understanding of trends and opportunities in *active transportation*.

The Transportation Tomorrow Survey could be expanded, or a parallel research project created, to gather detailed information on *active transportation*, including all walking and cycling trips.

Direction 5: Improve the understanding of the inter-dependence between transportation and human health in the *GTHA*.

Create partnerships with health professionals, researchers and related organizations to develop baseline *GTHA* data on current health and transportation-related indicators.

Direction 6: Support research on clean fuel technologies and green vehicles, and develop programs to provide incentives for their use.

Direction 7: Implement pilot and demonstration projects.

Pilot and demonstration projects that help build local knowledge and expertise, demonstrate best practices and serve as demonstration sites could be implemented.

Possible Options:

i. Integrated land use and transportation initiatives at *mobility hubs*.
ii. Lane conversions on busy *arterial roads* or highways to *High Occupancy Vehicle* (*HOV*) or reserved-transit lanes.
iii. Road capacity enhancement projects, such as tidal flow operations, contraflow lanes, dynamic lanes, continuous flow intersections, diverging diamond interchanges, shoulder bus lanes, roundabouts, reversible lanes, and moveable barriers.
iv. "*Naked streets*", where normal cues such as signage and sidewalks are eliminated, resulting in an environment in which pedestrians have the right-of-way and vehicles proceed more cautiously.

Direction 8: Improve transportation modelling interface.

Building on this region's reputation as a leader in transportation modelling, municipalities, provincial ministries, and educational and research organizations could partner to improve the coordination and standardization of transportation data collection/analysis and demand forecasting and backcasting models, particularly related to emerging issues. These could include the impacts of climate change, resource depletion, travel behaviour changes, demographic changes, and integration with land use.

Direction 9: Re-examine the specialized transit delivery model.

The existing specialized transit delivery model could be re-examined, in consultation with user groups and other stakeholders, such as municipalities and the Ministries of Health and Long-term Care and Education. This could include consideration of pooling and coordinating all vehicles and operators involved in non-conventional transit service, including school transportation, to achieve the most efficient use of resources. It could also include examining ways to improve customer service, to coordinate across jurisdictional boundaries, and to explore the evolving relationship between specialized and conventional transit.

2.6 Partnerships and Decision-Making

Ongoing dialogue and partnerships are critical to building a transformational regional transportation system for complete mobility that transcends traditional municipal and other administrative boundaries. This includes establishing decision-making processes in which well-informed citizens are full and active participants.

Direction 1: Coordinate transportation planning and delivery across governments, sectors and stakeholders.

Metrolinx was created to coordinate transportation planning and delivery across governments, sectors and stakeholders. Possible options for fulfilling this mandate include:

i. Creating mechanisms to resolve system gaps and bottlenecks between municipalities.
ii. Pursuing partnerships with the federal government for the implementation of the RTP.
iii. Establishing a process to ensure that the decision-making of provincial ministries and agencies supports the RTP.
iv. Establishing a formal mechanism for interaction between stakeholders to advance policies, standards and the alignment of priorities.
v. Systematically evaluating the feasibility and desirability of using public-private partnerships to accelerate investment in additional rail, transit and road capacity, while retaining effective public control.
vi. Facilitating or managing *mobility hub* development projects.

Direction 2: Expand the role of municipal transportation advisory committees.

All municipalities could follow the lead of several municipal governments in the *GTHA* by establishing dedicated citizen advisory committees to advise councils and develop programs on matters related to *active transportation*, transit, and *transportation demand management*.

Direction 3: Ensure that decision-making is informed by a full and complete understanding of the impacts on all aspects of the transportation system.

Possible Options:

i. An evaluation of opportunities to incorporate all transportation modes be required as part of the Environmental Assessment process for road construction, reconstruction or widening.

ii. All municipalities follow the lead of several municipal governments in the *GTHA* by obtaining the input of local transit operators and public health departments on all major planning and transportation matters.

iii. Metrolinx as a commenting agency for major planning matters that could impact the transportation system or for local Transportation Master Plans.

iv. Broaden the scope of traffic impact studies to transportation impact studies that consider the impacts of new development on all forms of transportation, including transit, walking and cycling, as well as the impact of induced traffic.

Direction 4: Gather and disseminate knowledge about best practices in transportation planning.

A mechanism could be established for gathering and disseminating information on best practices in transportation planning, drawing on examples from similar organizations in comparable regions such as Agence métropolitaine de transport in the Montréal area and TransLink in the Vancouver region. Metrolinx could engage in collaboration with regional transportation agencies in other jurisdictions on specific initiatives.

3 Test Concepts

3.1 Introduction

This section describes three different transportation system infrastructure concepts. These concepts, as well as a Business-As-Usual (BAU) concept, have been developed as test concepts for the purpose of modelling how different systems would perform with regard to the vision, goals and objectives set forth in White Paper 1.

Each concept takes an alternative approach to addressing the present and future transportation needs of the *GTHA* (looking forward 25 years from the base year of 2006). Additional variations with respect to road capacity were further tested, and the results of this analysis are presented in Appendix E. The alternatives are not intended to be mutually exclusive and it is anticipated that elements from each could form part of the recommended Draft RTP.

The test concepts will also inform the potential range and scale of transportation financing and pricing options to be detailed in the Investment Strategy.

The three system test concepts were developed based on several inputs:

- the vision, goals and objectives presented in White Paper 1;
- the ideas and concepts presented in the Green Papers;
- the gaps and deficiencies in the transportation system that were identified during the consultation process on the Green Papers, and through discussions with municipalities and stakeholders;
- municipal Transportation Master Plans (TMPs) and Official Plans; and
- provincial policies and plans.

What We Have Learned

The following observations were gathered from the research compiled in the Green Papers and through stakeholder consultations.

i. There is a lack of convenient, auto-competitive transit service and poor internal connections in the exurban areas of the region.
ii. The mid-portion of the region lacks sufficient *higher-order transit* service in an east-west direction.
iii. The transportation system does not adequately support the directions in the Growth Plan on intensification, creating compact, walkable, transit-supportive communities, and supporting and linking *urban growth centres*.
iv. The region lacks *higher-order* inter-connected transit service between Pearson Airport and Union Station.
v. The current inter-regional services focused on Union Station, as well as significant portions of the urban transit network, are well-used, with latent demand that needs to be accommodated by additional service.
vi. There are a number of socially and economically disadvantaged areas that are under-served by transit. Connections between these areas and employment areas are inadequately developed.
vii. A substantial proportion of the *GTHA* population, approximately 35 per cent, does not have a driver's licence. This group's reliance on transit is high and their mobility is potentially limited, depending upon where they live.
viii. Local transit service is not adequately integrated with the GO Transit rail network.
ix. The system is overly focused on access to transit by car, and lacks non-auto-based connections between major transit hubs and destinations.
x. Travel patterns indicate there is a growing percentage of cross-regional trips, therefore convenient connections/transfers between transit services is critical to maintain the competitiveness of transit (e.g. route, scheduling, fare integration and high-quality traveller information is required).
xi. Municipal/regional boundaries and operating jurisdictions have presented barriers to better, more efficient, transportation service.

The MoveOntario 2020 Transit Plan (see Appendix B), which includes Toronto's Transit City Plan, was a key input to the development of the transportation system test concepts. The projects included in the MoveOntario 2020 Plan were used as the base for all of the test concepts, with additional elements being added to serve growth beyond 2020 and to integrate them with an overall regional transportation system.

In addition to physical improvements to the infrastructure, some of the policy and program directions described in Section 2 are assumed to be in place to support each test concept.

Each of the test concepts also assumes an urban structure appropriate to the particular needs and requirements of the concept. All of the concepts are based on the land use patterns and requirements of the Growth Plan. At minimum, they each achieve the requirements of the Growth Plan for densities and intensification rates, and all of the concepts are based on the growth forecasts of the Growth Plan for each regional municipality and the cities of Hamilton and Toronto.

Recognizing that *higher-orders of transit* service will require greater concentrations of both people and jobs to support them, the concentrations of growth in and around *mobility hubs* varies between the different concepts. To reflect this variation, different anchor hubs with different population plus employment assumptions have been identified for each of the concepts. Table 3.1 describes the assumed population and employment levels in all anchor hubs, and select gateway hubs, for the three test concepts.

The designation of anchor hubs in each of the three concepts was determined by:

i. their strategic location (the presence of regionally significant facilities);
ii. the level of contemplated transit service; and
iii. their transit-oriented development potential.

The resulting distribution of anchor hubs for each concept is illustrated in the test concept maps in Appendix C.

3.2 The Test Concepts Defined

3.2.1 Business-As-Usual (BAU) Test Concept

The Business-As-Usual (BAU) Test Concept includes all committed transportation projects, not including the full suite of MoveOntario 2020 projects announced in 2007.

Metro

- Extension of the Spadina subway to Vaughan Corporate Centre.

Other *Rapid Transit*

- Lines on Main Street and Queen Street in Brampton.
- A line from Steeles Avenue to Richmond Hill Centre on Yonge Street.
- The Mississauga Transitway.

The BAU Test Concept includes all currently programmed improvements to the Ontario Ministry of Transportation (MTO) highway network, including the *High Occupancy Vehicle* (*HOV*) network, and the Highway 407 East extension to Highway 35/115. Because most major municipal roads are financed through development charges, which provide a relatively stable and predictable source of funding, the planned regional major *arterial* improvements were included. The BAU reference concept therefore includes all major roads in the 10-year municipal road programs and longer-range road network expansion plans in the Transportation Master Plans (TMPs) of the cities of Toronto and Hamilton and the regional municipalities of Halton, Peel, York and Durham.

Under the BAU Test Concept, implementation of municipal *active transportation* networks is anticipated to proceed at rates similar to those of recent years. A similar assumption applies regarding improvements to the movement of goods and delivery of services within the *GTHA*; these will continue to be made largely by trucks, and truck movements will be subject to the same congestion delays as automobile traffic.

The land uses proposed under the BAU Test Concept are based on the Growth Plan and are identical to the land uses assumed for Test Concept A.

3.2.2 Test Concept A: LINEAR

The Linear Test Concept is based primarily on the MoveOntario 2020 projects and other proposed system improvements with the following additional services to complete connections, fill system gaps, and address growth beyond 2020.

Express Rail

- A Lakeshore *Regional Express* line between Hamilton and Oshawa (based on electrification of the Lakeshore GO Transit rail line as included in MoveOntario 2020).

Commuter Rail

- *Commuter rail* service linkages outside the *GTHA*.

Metro

- Extension of the Scarborough Rapid Transit (SRT) to Malvern Town Centre.

Other *Rapid Transit*

- Extension of a line on Hurontario Road north to Mayfield Road.
- A line on Dundas Street in Halton and in Mississauga.
- A new east–west line in York north of Highway 7.
- A line in the Highway 407 / 401 corridor from Halton to Durham.
- A north/south line in Pickering joining North Pickering with downtown Pickering.

The basic highway system in this test concept comprises programmed MTO municipal projects and projects in municipal TMPs (as in the BAU reference concept). In addition, this concept includes Highway 407 East, the GTA-West proposed travel corridor that links Highway 400 to the Guelph area, the Niagara-GTA project, and extensions to Highway 404 and Highway 427 as defined in the *Growth Plan for the Greater Golden Horseshoe*. A network of *High Occupancy Vehicle (HOV)* lanes is also included in the Linear Test Concept, based on the MTO-planned system. *Active transportation* networks planned by municipalities are assumed to be completed as a component of all test concepts.

The land uses proposed under the Linear Test Concept are consistent with the minimum requirements of the Growth Plan in terms of growth forecasts, and density and intensification targets. Under Concept A, in order for a *mobility hub* to qualify as an anchor hub for the purposes of the model, it needed to be served by *higher-order transit*, contain regionally significant facilities, and achieve a threshold level of population plus employment of at least 25,000 within its *transit catchment area* (see Table 3.1). This allocation results in approximately five to 10 per cent of the upper or single-tier's employment plus population growth locating within its anchor hub(s). These are estimates only, and they relate to *transit catchment areas* that have not been precisely delineated.

A map of the Linear Test Concept is included in Appendix C

3.2.3 Test Concept B: RADIAL

The Radial Test Concept builds on Test Concept A by strengthening several major transit corridors radiating from Union Station. *Regional Express* lines providing very high levels of rail service are a major part of the Radial Concept. *Regional Express* lines would provide a high-frequency and high-speed (average 80 km/h or more) service by electrified railways or other higher-order technologies.

The *higher-order transit* systems include all of the MoveOntario 2020 projects plus the following:

Express Rail

- *Regional Express* lines in the Lakeshore corridor from Oshawa to Hamilton, on the Milton line between downtown Toronto and Mississauga City Centre, to Pearson Airport from downtown Toronto, and a Don Valley express line using existing and abandoned rights-of-way from Union Station to Richmond Hill. This last project is intended to supplement the capacity of the Yonge Street subway by providing a parallel express line with limited stops.

Commuter Rail

- *Commuter rail* service linkages outside the *GTHA*.

Metro

- A new *metro* line on Eglinton Avenue between Kennedy station in Scarborough and the Pearson Airport/Renforth Gateway area, east and west extensions of the Sheppard subway line (to the Spadina subway and to Scarborough Town Centre) and extension of the SRT line to Malvern.

Other *Rapid Transit*

- Two lines in Hamilton, north/south in the James Street corridor leading to Hamilton Airport and east-west in the King Street corridor connecting to McMaster University.
- Extension of the Hurontario line to Mayfield Road.
- A line in Hamilton in the Mohawk Road corridor.
- A line between Hamilton and Halton through the Waterdown area.
- North/south lines to Milton from Highway 5 and along Trafalgar Road from Midtown Oakville to Highway 407.
- A new east-west line in York north of Highway 7 between Vaughan Corporate Centre and Markham Centre in the Major MacKenzie Road corridor.
- A Highway 407 line from Halton to Durham.
- A Steeles-Taunton line in Durham between the Don Mills line and Oshawa.
- A north/south line along Brock Road from North Pickering to downtown Pickering.
- A north/south line in Whitby in the Brock Street corridor.
- An east-west express bus corridor in the Highway 401 corridor across Toronto using *High Occupancy Vehicle* (*HOV*) lanes.

In the Radial Test Concept, only programmed road improvements have been included, as well as the Highway 407 East Extension which is now undergoing an environmental assessment. The *HOV* network as developed for the Linear Test Concept is also included. The Radial Test Concept does not include the GTA-West or the Niagara-GTA travel corridors. To assess the effects of road capacity on the performance of the overall system, a variation of the Radial Test Concept, which includes additional road capacity, is discussed in Appendix E .

In this concept, there would be greater concentrations of growth around more anchor hubs that are more dense, to reflect the increased accessibility provided to these hubs by the radial routes and other high-speed transit improvements (see Table 3.1). Anchor hubs in Test Concept B have strategic locations, the presence of high-speed transit, and a threshold population and employment set at 50,000 people and jobs within the *transit catchment area* (see Table 3.1). Twelve such hubs are identified in Test Concept B. These hubs would typically be expected to receive between 10 to 15 per cent of their upper or single-tier's population plus employment growth. These are estimates only, and they relate to *transit catchment areas* that have not been precisely delineated.

A map of the Radial Test Concept is included in Appendix C.

3.2.4 Test Concept C: WEB

The Web Test Concept provides enhanced radial service to and from Union Station, as in the Radial Test Concept, but also adds major new east-west *higher-order transit* lines. It also includes additional *rapid transit* services within the City of Toronto, covering all *rapid transit* corridors that have been identified in the City's Official Plan. The network for this test concept is a fully integrated, hierarchical transit system that will connect most of the *urban growth centres* in the *GTHA*. In addition to the MoveOntario 2020 projects this option includes:

Express Rail

- *Regional Express* corridors on the Lakeshore line from Hamilton to Oshawa; to Mississauga City Centre, Pearson Airport, downtown Brampton and Richmond Hill Centre from downtown Toronto; from Pickering through Markham,

Richmond Hill Centre, Vaughan Corporate Centre, Pearson Airport, and Mississauga City Centre to Midtown Oakville; and an east/west line along Highway 401 from Scarborough Centre to Renforth Gateway/Pearson Airport.

Commuter Rail

- *Commuter rail* services linkages outside the *GTHA*.

Metro

- New *metro* line along Queen Street in Toronto linking with the Bloor-Danforth subway both in the east and west areas of the city, and an Eglinton *metro* line from Kennedy station to Pearson Airport.
- Extension of the Sheppard Subway to Downsview in the west and to Scarborough Town Centre in the east.
- An extension of the Scarborough Rapid Transit (SRT) line to Malvern Town Centre.

Other *Rapid Transit*

- Two lines in Hamilton, along James Street and east/west on King Street to McMaster University
- An extension of the Finch line east to Seneca College.
- The Hamilton "T" line along Mohawk Road.
- Lines between Hamilton and Halton through the Waterdown area.
- A line along Dundas Street in Mississauga and Halton from Hurontario to Burlington.
- North/south lines from Milton to Lake Ontario and along Trafalgar Road to downtown Oakville.
- A link from Markham Centre to downtown Oshawa via Highway 407 East.
- A Steeles-Taunton link from York University to downtown Oshawa.
- A north/south line along Brock Road from North Pickering to downtown Pickering.
- A north/south line in Whitby in the Brock Street corridor.
- All *rapid transit* corridors that have been identified in the City of Toronto's Official Plan.

The highway network is the same as in the Radial Test Concept. To assess the effects of road capacity on the performance of the overall system, a variation of the Web Test Concept, which includes decreased road capacity, is discussed in Appendix E .

In this concept, the presence of both radial and circumferential high-speed lines creates a web that enables more anchor hubs to be served by at least two high-speed transit lines, particularly at the locations where the circumferential and radial lines cross. The concept, therefore, envisages a slightly greater number of larger anchor hubs (in excess of 50,000 population plus employment) than in the Radial Test Concept (see Table 3.1), with a higher proportion of growth allocated to locations whose transit service has significantly increased over the Radial Test Concept. Fourteen such hubs are identified under Test Concept C. Anchor hubs in this concept would typically be expected to attract 10 to 20 per cent of their upper or single-tier's employment plus population growth. These are estimates only, and they relate to *transit catchment areas* that have not been precisely delineated.

A map of the Web Test Concept is included in Appendix C.

3.3 Model Approach and Methodology

Following are the input assumptions to the Greater Golden Horseshoe Model (the MTO's transportation demand forecasting model covering the *Greater Golden Horseshoe* area), that were used for generating the test concept performance comparisons.

- **Population, employment, land use and socio-economic characteristics:** Year 2031 projections at the traffic zone level (~3000 zones), consistent with the population and employment forecasts of the Growth Plan at the single and upper-tier level, consisting of population by age, occupation status, dwelling type, household structure and

employment by type. All test concepts assume that the Growth Plan's minimum requirements for intensification and density have been met. For each test concept, a different system of anchor hubs, as well as select gateway hubs, has been identified. For the purpose of modelling the three tests concepts, population and employment levels have been assumed for each of the hubs as listed in Table 3.1. These are estimates only, and they relate to *transit catchment areas* that have not been precisely delineated.

Table 3.1 Population and Employment Assumptions for Anchor Hubs and Select Gateway Hubs for the Purpose of Modelling

Anchor and Select Gateway Hubs	Test Concept A - Linear	Test Concept B - Radial	Test Concept C - Web
Downtown Brampton	●●	●●●	●●●
Downtown Burlington	●●	●●●	●●●
Downtown Hamilton	●●	●●●	●●●
Downtown Milton	●●	●●	●●
Downtown Oshawa	●●	●●●	●●●
Downtown Pickering	●	●	●
Downtown Toronto	●●●●	●●●●	●●●●
Etobicoke Centre	●●	●●●	●●●
Markham Centre	●●●	●●●	●●●●
Midtown Oakville	●●	●●●	●●●
Mississauga City Centre	●●	●●●●	●●●●
Newmarket Centre	●	●	●
North York Centre	●●●	●●●●	●●●●
Pearson Airport	●●●	●●●	●●●
Richmond Hill/Langstaff	●●●	●●●	●●●
Scarborough Centre	●●●	●●●	●●●●
Vaughan Corporate Centre	●●	●●●	●●●
Yonge Eglinton	●●	●●	●●

Population and employment assumptions for the purpose of modelling (anchor hubs shown in red):

0 – 25,000	●
25,000 – 50,000	●●
50,000 – 100,000	●●●
100,000 +	●●●●

- **Road network:** The highway network includes all elements in the province's five-year capital program, and the *arterial road* network includes all road improvements as per the Transportation Master Plans of each upper- and single-tier municipality. The Linear Test Concept includes Highway 407 East, the GTA-West proposed travel corridor that links Highway 400 to the Guelph area, and the Niagara-GTA project , while the Radial and Web Test Concepts and the BAU Reference Concept include only the Highway 407 East corridor. Variations on the Radial and Web Test Concepts that increase and decrease the assumed road capacity are discussed in Appendix E.
- **Marginal auto operating cost** in test Concepts A, B and C is assumed to increase 100 per cent in real terms from 2006 levels to capture potential increases related to increases in gas prices and/or implementation of road pricing. A 50 per cent increase is assumed for the BAU Concept, reflecting gas price increases. Possible road pricing schemes will be assessed more explicitly when preparing the Draft RTP and the Investment Strategy.
- **Non-residential parking costs** in the Linear, Radial and Web Concepts are also assumed to increase by 50 per cent in real terms over the 2006 levels in mature urban areas with existing paid parking. In addition, areas subject to paid parking have been expanded to include *urban growth centres*, nodes/corridors and major employment areas in urbanized areas with high densities (ranging from $6 to $18 per day). In the BAU Concept, parking costs remain unchanged in real terms.
- **Bus, streetcar and *paratransit* network** in all four concepts is assumed to be expanded into new urbanized areas (e.g. designated greenfield areas); improved service levels (frequencies) are assumed, consistent with population growth and projected transit mode share increases for each test concept based on typical bus loading standards.
- **Transit fares** in all four concepts are kept at the same level as in 2006, in real terms, with fare integration between the local transit operators to eliminate double fares for short cross-boundary trips.
- ***Higher-order transit*** *headways* and average operating speeds have been assumed as shown in Table 3.2:

Table 3.2 Headways and Operating Speeds of Various Modes

Mode	Peak Period Headway (min)	Average Operating Speed (km/h)
Regional Express	5	80
Commuter Rail (GO Rail)	10	50 – 60[i]
Metro (Subway/SRT)	2	40
Other *Rapid Transit* (LRT, BRT)	2 – 3	30 – 80[ii]

i. 50 km/h on all-stop services and 60 km/h on express services
ii. 30 km/h on surface LRT/BRT; 80 km/hr on grade separated Transitway (e.g. 407 Transitway)

3.4 Limitations of the Model

Like all state-of-practice models, the model used in the preparation of this paper has limitations that must be considered when interpreting its results. Among them are the following:

- **Observed behaviour:** the model captures people's current perceptions of the modes available and observed travel behaviour. As such, it may underestimate the impacts of new modes and aggressive policies that do not exist today, as there is no observed behaviour from which to extrapolate.
- **Modal bias:** the model is not sensitive to changes in non-quantifiable measures, such as comfort, cleanliness and image. Hence, attitudes toward buses, for example, are assumed to be constant and only the impacts of changes in cost, in-vehicle and out-of-vehicle travel time, and transfers are modeled.

- **Regional scale:** the model is based on a grid of 3,000 traffic zones for the *Greater Golden Horseshoe*, which is at a scale too large to provide sufficient detail at a local level and for short trips.
- **Modelling error:** error is inevitable given the aggregations and simplifications necessary to model every trip for every person in the *GGH*.

4 Test Concept Performance – Preliminary Findings

4.1 Introduction

To gain a better understanding of the long-range performance and costs of the test concepts described in Section 3, a transportation computer model was applied to estimate future travel patterns of *GTHA* residents. The computer model takes into account where people live, work, go to school or are travelling to for other purposes, and what travel options are available to make these trips. Through simulation, the model then determines what travel routes and modes might be used and estimates the trip volumes on roads, transit and walking/cycling facilities throughout the region.

The computer model simulates the behaviour of individual travellers taking into account the different costs (e.g. fares, tolls, parking charges, etc.) and travel times (e.g. walking, waiting, in-vehicle) via the available modes (e.g. auto, transit or walk/cycle) for that individual's trip. Different types of people behave differently and thus key socio-economic characteristics that affect travel and travel choices such as age, employment status, occupation type, household structure (e.g. single, married, married with children, etc.) are reflected when determining one's propensity to use a given mode. The computer model covers the entire *GTHA* and surrounding areas. Projections have been made for the year 2031 for the three-hour morning peak period of a typical weekday, when work and school trips are most concentrated and the network is experiencing maximum demand levels.

It is important to note that despite the model's sophistication, it is an inherently simplified view of the world and cannot fully simulate the complexity of our lives and future trends. It is also limited by the information that is traditionally collected by, and available to, transportation planners and engineers. For example, regional economic trends, social values and environmental concerns are reflected in the model as they manifested themselves in the travel behaviour of various socio-economic groups at the time(s) for which the model was calibrated. Model estimation of behavioural responses to major changes in those trends and attitudes (beyond the range of variation in the calibration data) would be subject to more uncertainty; simulated changes in behaviour may tend to be under-estimated in such cases.

In addition, while the model generally accounts for differences in land use patterns, demographics and the availability of transportation infrastructure and service levels (e.g. measures of travel times, costs and convenience), the full impacts of many of the programs and policies discussed in Section 2 are not directly incorporated into the model, nor are the impacts of those policies and programs reflected in the preliminary findings. For example, the model does not directly take into account how travel choices would be affected by major improvements in off-street walking and cycling networks, a bike-sharing program, regular marketing programs to inform households about transportation alternatives or widespread use of an online regional transportation information portal. To the extent that the policies and programs in Section 2 are designed to encourage use of the more sustainable transportation modes (e.g. transit, walking and cycling), the model likely under-estimates the use of such modes.

Therefore, it should be acknowledged that the model is not a crystal ball, and the results presented in this section should not be taken as definitive statements about future conditions under the three test concepts; however, the findings do provide a useful comparison of the relative demand levels/patterns and performance levels between the concepts.

The following sub-sections describe the estimated costs, performance levels and performance/cost implications of the three transportation system concepts described in Section 3, and the BAU Test Concept. Preliminary findings are presented. Reflecting the uncertainties associated with any future forecast, the projections and performance measures are subject to standard forecasting error, but provide a sufficiently accurate basis upon which to show the relative differences between the concepts for planning purposes. They are also subject to further fine-tuning, based on further modelling that will take place for the Draft RTP. Readers, are therefore, advised that the value in these results is primarily in relating the results of different concepts to each other, as opposed to predicting absolute outcomes.

4.2 Preliminary Cost Estimates

Capital Costs

Pre-engineering capital costs for system expansion were estimated for the three test concepts and the BAU Concept based on industry-standard unit costs, and costs for similar types of road and transit facilities. Broad assumptions were made with respect to the need for structures, tunnelling and other higher-cost construction activities. Contingency estimates were added to reflect property acquisition and other cost uncertainties. For transit facilities, a cost component for transit vehicles was also included in the capital costs. These are costs for system expansion and do not include capital costs for ongoing rehabilitation of existing and new facilities. The estimates do not include the costs of operating additional programs as outlined in Section 2.

Capital cost estimates for the BAU Concept and each of Test Concepts A, B and C are shown in Table 4.1 and assume a 25-year investment period.

Table 4.1 Order of Magnitude Capital Cost Estimates (billions of 2006 dollars)

	BAU	Test Concept A - Linear	Test Concept B - Radial	Test Concept C - Web
Rapid and Local Transit	5	40	60	80
Regional Roads and Provincial Highways	15	20	15	15
Total[i]	20	60	75	95
Annual[ii]	0.8	2.4	3.0	3.8
Per capita (in 2006 dollars per year)	93	279	349	442

i. Road and transit capital costs for expansion.
ii. Annual cost assumes a 25-year investment period.

These order-of-magnitude costs are intended to show the relative cost differences between the concepts. They are intended for planning purposes only. They do not reflect the likely efficiency gains from increased capacity in the industry or from specialization. Nor do they reflect the efficiency gains experienced by other jurisdictions with ongoing infrastructure programs, where public and private partners can efficiently and continually deploy human and technical resources and achieve economies of scale.

It is important to note that the costs will be borne by a significantly larger population than today's. As Table 4.1 above shows, when divided by the 2031 population of 8.6 million residents, capital costs per capita are between $93 and $442 annually, and are much lower than the annual costs of owning and operating a car. Furthermore, funding could come from a variety of sources, including the private sector. Metrolinx's companion Investment Strategy will align the RTP 25-year capital cost estimates and annual transit operation cost estimates against a proposed suite of dedicated revenue and funding tools.

Finally, it is also important to note that each test concept is only a test, not a plan. A more complete analysis will further help identify which projects should be prioritized based on the goals and objectives outlined in White Paper 1.

It is clear that for all of these concepts, investments would allow millions more people to travel to work and elsewhere by transit than are currently able.

Operating Costs

Operating costs have not been fully calculated for all modes. Table 4.2 introduces transit operating costs, excluding the continued substantial operational spending on roads and highways.

The numbers below demonstrate that the operating requirements will grow significantly, with a 137.5 per cent increase between 2006 and Test Concept C.

Table 4.2 Transit Operating Cost Estimates (billions of 2006 dollars)

	2006	BAU	Test Concept A - Linear	Test Concept B - Radial	Test Concept C - Web
Transit Operating costs (in billions of 2006 dollars per year)	1.6	2.1	2.6	3.3	3.8

4.3 Performance Comparisons

The three alternative long-range system test concepts have been assessed and compared in Appendix D using some of the quantitative indicators described in White Paper 1. They reflect the three major pillars of the transportation vision for the *GTHA*:

- A high quality of life for people;
- A thriving, healthy and protected environment; and
- A strong, prosperous and competitive economy.

4.3.1 A High Quality of Life

A pivotal goal of the RTP is for the transportation system to provide more options for moving people and goods around the entire region conveniently, comfortably and safely, with minimum disruption to neighbourhoods and connecting people with the places they need to go.

A Greater Role for Transit

A key indicator of success is the proportion of trips made by transit and *active transportation* modes. In the Web Test Concept C, the combined *modal split* for non-car modes almost doubles to reach close to 40 per cent of all morning peak trips. This is without taking into account the effects of the variety of policies discussed in Section 2, except for a generalized increase in the cost of driving. This *modal split* would be an extraordinary achievement.

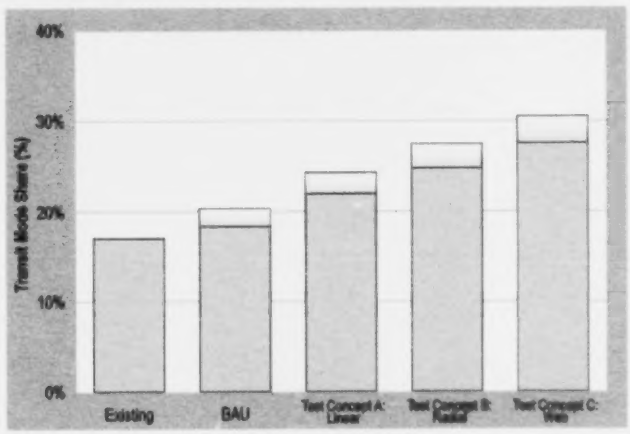
Increases between the 2006 situation and Test Concepts A to C, as shown in Table 4.3, can be explained by greater *rapid transit* infrastructure investment, and the concentration of population and jobs within close proximity to them, as described in Section 3.

Table 4.3 Share of Morning Peak Period Trips by Transit and Active Transportation

Concept	Transit	*Active Transportation*	Transit + *Active Transportation*
Current	16.5 %	9.0 %	25.5 %
Business-As-Usual	17.0 %	9.0 %	26.0 %
Test Concept A - Linear	23.0 %	9.5 %	32.5 %
Test Concept B - Radial	26.0 %	10.0 %	36.0 %
Test Concept C - Web	29.0 %	10.5 %	39.5 %

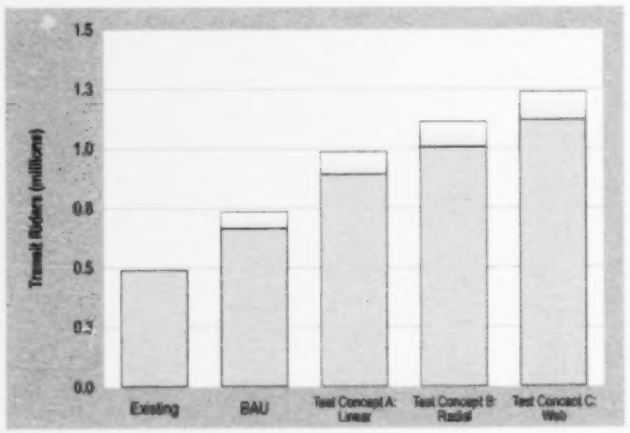
The relatively low increase in *active transportation* may be explained by the assumptions of the model, which mainly reflect the effects of land use changes in generating more short trips (thereby increasing the propensity to walk or cycle) but do not capture directly the other policies and programs for *active transportation* as proposed in Section 2. A greater increase in *active transportation* may result from the implementation of these policies and programs.

Figure 4.1 Transit Mode Share – AM Peak Period



Ranges illustrate uncertainties in forecasts.

Figure 4.2 Transit Riders – AM Peak Period



Ranges illustrate uncertainties in forecasts.

Significantly Greater Capacity

The increase in the share of transit shown above in Table 4.3 and in Figure 4.1 — from 17 per cent in 2006 to 29 per cent under the Web Test Concept — does not tell the whole story. Because of the anticipated population growth and a projected increase in the average trip length from home to work, it would take significant transit investment merely to allow the same proportion of commuters to continue to be accommodated on transit.

The modal share shown in Table 4.3, multiplied by the much greater population and travel volumes projected for the year 2031, means that dramatic increases in transit ridership are projected as shown in Figure 4.2; 2.0, 2.3 and 2.5 times greater than 2006 levels for Test Concepts A, B and C, respectively.

The increase in the number of transit trips is shown in Table 4.4, with a much greater rate of growth than the share of transit.

Table 4.4 Increases in Transit Trips from Current (2006) Levels

Concept	Increases in Transit Trips from Current (2006) Levels
Business-As-Usual	+ 50 %
Test Concept A - Linear	+ 101 %
Test Concept B - Radial	+ 127 %
Test Concept C - Web	+ 155 %

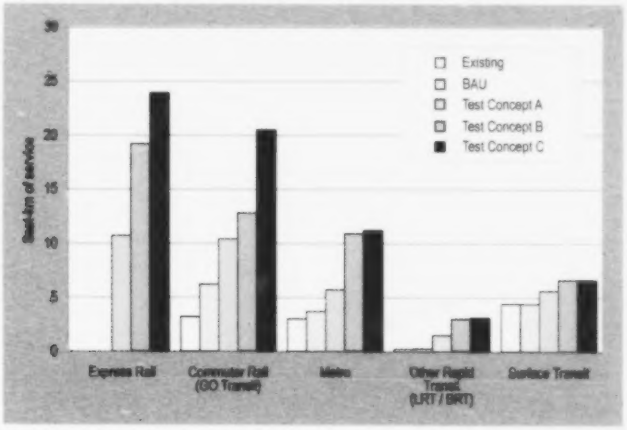
As illustrated in Table 4.5, there is tremendous growth in the length of *rapid transit* infrastructure under each of the three test concepts.

Table 4.5 Rapid Transit Network Length (km)

Transit Mode	2006	BAU	Test Concept A - Linear	Test Concept B - Radial	Test Concept C - Web
Regional Express	0	0	120	200	440
Commuter Rail	420	420	570	540	620
Metro	70	80	100	150	160
Other *Rapid Transit*	50	100	650	700	860
Total *Rapid Transit*	540	600	1,440	1,590	2,080

The test concepts progressively show a significant increase in the number of seats available on transit vehicles, in all transit modes, as shown in Figure 4.3.

Figure 4.3 Increase in Transit Supply



Despite a relatively modest increase in the estimated future share of *active transportation*, the total number of walking and cycling trips is projected to increase significantly for every test concept. The full reflection of proposed programs and policies, including *active transportation* infrastructure, that is not reflected in the model, would boost these figures even higher.

Table 4.6 Increases in Active Transportation Trips

Concept	Increases in *Active Transportation* Trips
Current	–
Business-As-Usual	35 – 45 %
Test Concept A - Linear	43 – 53 %
Test Concept B - Radial	51 – 61 %
Test Concept C - Web	59 – 69 %

Linking People to Places

In addition to reflecting a fast-paced infrastructure program, an ambitious change is contemplated for how transit will be integrated with the way in which we design and build communities.

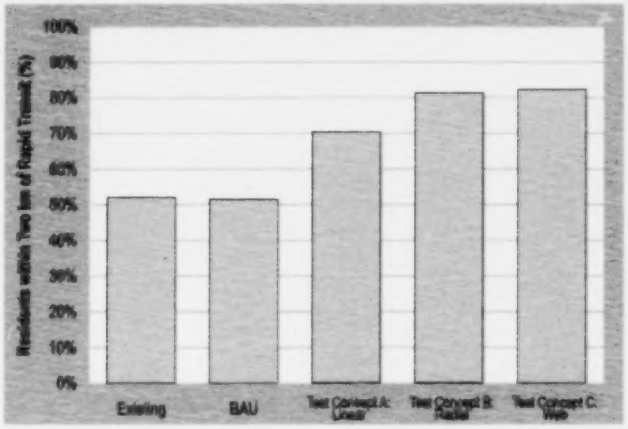
The proposed concepts show a significant difference in how close people live to transit. From the current situation in which only 11 per cent of the population lives within 500 metres — or walking distance — of *rapid transit*, Concept C would almost triple that percentage. With the significant population growth we are expecting, we would be bringing *rapid transit* to the doorsteps of millions more people. The model also shows that from 52 per cent today, up to 82 per cent of residents would live within two kilometres of *rapid transit* — a short distance that lends itself well to cycling, local transit or being dropped off.

Table 4.7 Rapid Transit Coverage

Percentage of People Who Live Within Walking Distance (500 m) of a *Rapid Transit* Line	
Current	11 %
Business-As-Usual	13 %
Test Concept A - Linear	25 %
Test Concept B - Radial	30 %
Test Concept C - Web	35 %

Along with the location of work places, proximity to transit is a fundamental element to help people choose transit. Infrastructure is an important prerequisite, but only the first step to transformational change. It is the successful implementation of programs and policies that will make the difference between residents walking to their nearest *mobility hub* to take transit, or driving by. Therefore, the greater availability of *rapid transit* to more people is a key finding of the model.

Figure 4.4 Residents within Two km of Rapid Transit



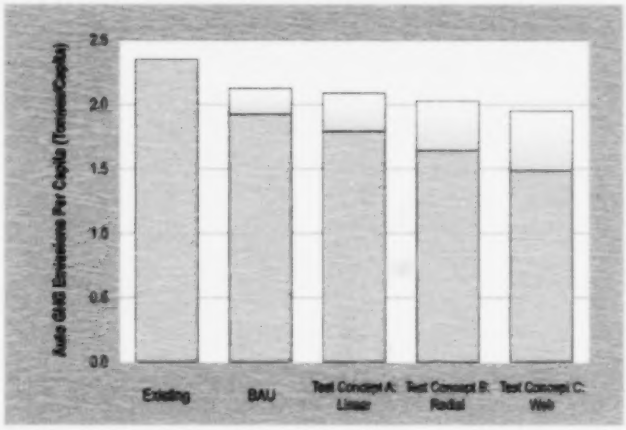
4.3.2 A Thriving, Healthy and Protected Environment

The Challenge of Climate Change

Climate change is the most daunting challenge facing the world today. Canadians are among the world's largest producers of greenhouse gases (GHGs) per capita and transportation is among the largest contributors at 31 per cent of Ontario's total emissions. The International Panel on Climate Change (IPCC) has recommended that emissions be reduced to stabilize the concentration of GHGs in the atmosphere. In its *Go Green Climate Change Action Plan*, the Government of Ontario has committed to a decrease in GHG emissions of six percent below 1990 levels by 2014, and of 15 per cent below 1990 levels by 2020. The *Go Green Action Plan* seeks to achieve 13 per cent of the province-wide reduction by 2020 from passenger vehicles and transit, and six per cent from freight and diesel emissions. These transportation emission reductions are significant, particularly given the growth in travel and emissions that has occurred since 1990.

Figure 4.5 shows per capita GHG reductions that can be expected from each of the test concepts. Ranges are provided to show how each test concept might perform in combination with an aggressive package of *Transportation Demand Management* measures such as those discussed in Section 2. Ranges also include an allowance for uncertainty. As additional transit infrastructure is introduced in Test Concepts B and C, per capita GHG emissions from autos could decrease by as much as 35 per cent from existing levels.

Figure 4.5 Auto GHG Emissions per Capita, 2031



Despite this positive prospect for per capita emissions, it is also important to consider absolute emissions, since it is the total amount of GHGs that drives GHG concentration in the atmosphere, and in turn affects climate change.

The challenge of adding 2.6 million people to our region while trying to reduce or even maintain existing levels of emissions should not be underestimated. As shown in Figure 4.6, the BAU Concept and the three test concepts differ significantly in their emissions profiles. Only Web Test Concept C shows a possible decrease in absolute auto emissions from existing levels, which corresponds to a 22 per cent reduction from the BAU Concept, when combined with an aggressive *TDM* program.

Figure 4.6 Annual Auto GHG Emissions, 2031

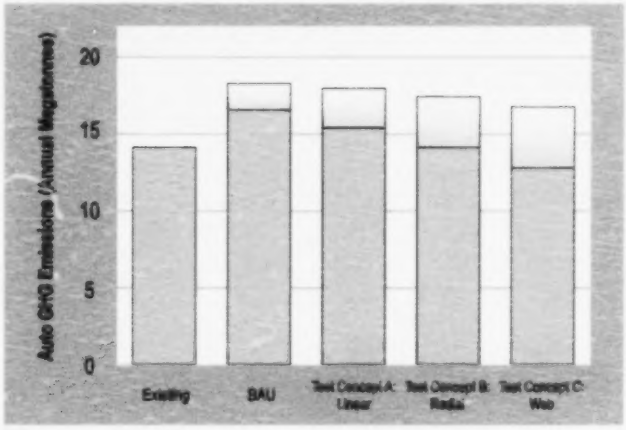


Table 4.6 below shows the performance of each scenario. Broad ranges are provided since there is substantial uncertainty about the future price and availability of oil, as well as the impact/use of more energy efficient vehicles. A key finding is that the BAU Concept and the three test concepts differ significantly in their emissions profiles.

Based on the above set of assumptions, although each of the test concepts reduce GHG emissions relative to Business-As-Usual, none of the concepts meet the *Go Green* target on their own. It is clear that the added contribution of the policies and programs described in Section 2 will be critical. Additional analysis illustrating how the *Go Green* target could be reached by building on Test Concept C is provided in Appendix F. This discussion considers a range of interrelated strategies, such as improvements to fuel efficiency of the vehicle fleet, as well as the provision of cleaner electricity to power subways, *LRT* vehicles, streetcars and hybrid/electric private vehicles.

Energy Use

While per capita energy use for passenger travel decreases as new transit infrastructure is introduced, as with GHGs, total energy consumption increases as the overall population of the region grows (see Appendix D). This figure may be even higher once heavy trucks are taken into account, reflecting the rapid growth of truck traffic. It is interesting to note that for transporting people, the amount of energy used by personal vehicles represents about 93 to 97 per cent of the total, with about three to six per cent for transit, even as the role of transit is growing substantially. Therefore, transit is critical to maintaining high levels of mobility in an energy-efficient manner.

As shown in Table 4.6, the BAU Concept and the three test concepts differ in their energy use just as they do in GHG emissions, with the substantial energy use and emissions estimated for the BAU Concept reduced progressively when moving from Concept A to Concepts B and C.

Table 4.8 Evolution in Greenhouse Gas Emissions and Energy Consumption

	GHG	Energy
Current (2006)	-	-
Business-As-Usual	+ 17 to + 30 %	+ 17 to + 30 %
Test Concept A - Linear	+ 9 to + 27 %	+ 10 to + 28 %
Test Concept B - Radial	+ 0 to + 24 %	+ 0 to + 24 %
Test Concept C - Web	- 9 to + 19%	- 9 to + 19 %

Air Pollutants

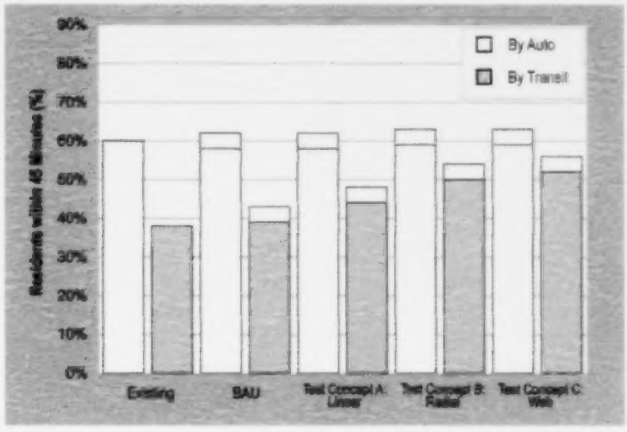
A number of pollutants are responsible for poor air quality, smog and other adverse effects such as acid rain. The model results, without the full range of programs and policies, show that absolute emissions of common air pollutants - CO, NOx and VOCs - decrease substantially under each test concept from 2006 levels (see Appendix D). This is primarily due to improvements in vehicle emission control technologies, as projected by Environment Canada. Other pollutants - SOx, PM10 and PM2.5 - increase somewhat from 2006 levels. These represent emissions from cars only and exclude emissions from trucks, locomotives and ships as well as home heating, industrial processes and pollutants from other jurisdictions carried by the wind. As with energy use and GHG emissions, increases in common air pollutants are less significant as new transit infrastructure is introduced.

4.3.3 A Strong, Prosperous and Competitive Economy

Quality Jobs for Ontarians

The capital investment required for all test concepts will help boost the economy by adding thousands of design, planning and construction jobs. Additional indirect and induced employment increases would also result, as will be documented in the Draft RTP.

Figure 4.7 Residents within 45 Minutes of Work by Car and Transit



Ranges illustrate uncertainties in forecasts

The per cent of *GTHA* residents within 45 minutes of travel to their workplace — owing to combinations of greatly improved transit and closer live-work distances in *urban growth centres* and *mobility hubs* — remains relatively constant for travel by car but increases significantly for travel by transit: from about 38 per cent in 2006 to about 54 per cent under Concept C in 2031.

Managed Congestion

No successful city-region anywhere in the world has completely eradicated congestion. The RTP will focus on moving people and goods, not just vehicles — and will provide improved choices in how to do so.

A comparison of today's situation, the BAU scenario, and Test Concepts A, B and C in terms of hours of delay and cost of congestion experienced by auto travellers is shown in Table 4.9.

Table 4.9 Congestion Impacts on Auto Travellers

Hours of Delay and Cost of Congestion (in 2006 dollars)		
	Delay (Auto Vehicle-Hours in AM Peak Hour)	Cost (Billions of Dollars Per Year)
Current (2006)	42,700	2.2
Business-As-Usual	84,500	4.2
Test Concept A - Linear	62,000	3.1
Test Concept B - Radial	54,000	2.7
Test Concept C - Web	50,000	2.5

Results in Table 4.9 show that projects included in the test concepts, along with assumed service levels and related measures, would help to hold the cost and delays caused by congestion close to present-day levels, even with the addition of 2.6 million more residents. For example, delays would increase by 17 per cent between 2006 and Test Concept C, but by 98 per cent — or close to double — between 2006 and the BAU scenario. Congestion-related costs follow the same pattern.

Safer Transportation

Everyone in our region knows someone who has been involved in a traffic accident. While Ontario's transportation system is among the world's safest, too many of us continue to get hurt while moving through the system.

Even if driving habits do not change and vehicles do not become safer, a preliminary interpretation of the model shows that under each test concept, including BAU, vehicle-kilometres-travelled (VKT) increase at a much lower rate than that of our population. If we assume a constant rate of incidents per kilometre travelled — a conservative assumption, given our enviable track record over the last 30 years — the fact that each person may drive less may very well help to save lives. The Draft RTP may enlarge on this working hypothesis.

4.4 Interim Findings

The following preliminary findings are based on the results of the model, with its assumptions and limitations acknowledged — for example, it does not include the full range of preliminary directions outlined in Section 2.

- Significant increases in transit use are achievable in the *GTHA* through bold transit investment, coordinated *rapid transit*/land use planning, and supporting policies and programs.
- Increasing population, jobs and economic output while reducing emissions and making up for a lost generation of transit investment is a formidable challenge that will require the participation of all governments, public and private stakeholders, and each resident of the region.
- Significant progress towards achieving the economic, social and environmental goals outlined in White Paper 1 can be achieved in the *GTHA* only through bold transit investment, a new approach to integrating transportation and land use, and supporting policies and programs.
- Greenhouse gas emissions are not estimated to drop sufficiently to meet provincial targets solely as a result of network and service improvements, as simulated in the model. Ambitious policy and program implementation will be needed to achieve desired GHG reductions, as outlined in Appendix F.
- Transit benefits are most significant when combined with aggressive land use intensification in transit corridors and *mobility hubs*. Intensification and density above minimum Growth Plan targets allows for further leveraging of transit investments and greater shifts from driving to transit.
- Large *mobility hubs* provide critical anchors to support any new *regional express/metro* facilities being considered. The extent to which the development potential at *mobility hubs* may be achieved will affect the timing and viability of major new cross-regional rail facilities. In terms of transit ridership and efficiency, concentrating an increased proportion of development in a relatively small number of anchor hubs, particularly those with high employment targets, is more effective than distributing similar levels of development growth over a more dispersed urban area.
- Preliminary findings indicate that a *regional express* system is viable, at least in part. It could have a major transformative impact on the *GTHA* with greatly enhanced cross-regional mobility and associated transportation, quality-of-life, environmental, and economic benefits.
- *Metro* improvements should be considered in existing higher-density areas if the higher range of transit market shares is to be achieved, reflecting the capacity limitations of LRT/BRT and the higher transit penetration that may be achieved with *metro*.
- Strong feeder bus and *paratransit* services need to be provided to support the *rapid transit* network under any future scenario, with fleet sizes doubling to quadrupling in suburban areas and with major increases in the City of Toronto.

4.5 Further Testing and Analysis

The development and assessment of transportation system concepts is, at this stage of the study, a work-in-progress. Additional model runs, analyses and comparative assessments will be carried out, leading to the preparation of the Draft RTP and draft Investment Strategy. More specifically, Metrolinx will continue its analysis to determine the optimal policies, programs and level of investment needed to achieve the goals and objectives outlined in White Paper 1.

In the meantime, the preliminary results presented in this White Paper are available for review and comment by stakeholders and the general public. Readers' opinions and comments are welcome.

5 Implementing the Plan

5.1 Introduction

The Regional Transportation Plan will set out a 25-year program to improve our quality of life, reduce our impact on the environment, and support a competitive, robust economy. As a result, implementing the RTP will involve much more than drawing lines on a map. While Metrolinx has, and will continue to have, the primary responsibility to coordinate transportation delivery in the *GTHA*, the two large cities, four regions and 24 local municipalities that comprise the *GTHA* each have responsibilities that are key to the success of the RTP. In addition, provincial ministries and transportation agencies retain their responsibilities to plan and provide elements of regional transportation infrastructure. There will also be an important role in plan implementation for individual citizens, non-governmental organizations, private businesses, health professionals, educators, and many other partners.

Metrolinx recognizes that the RTP's success will depend on a wide variety of initiatives including supportive land use, local transportation planning, capital investment, the implementation of *transportation demand management* initiatives, educational programs, and the delivery of infrastructure and service improvements.

Integration and coordination will be critical to ensure that all of these initiatives, undertaken by a multitude of partners, collectively support, and are consistent with, the implementation of the RTP.

5.2 Key Implementation Activities

As a new authority, Metrolinx will be working over the coming months to establish approaches to the coordination, integration, and in some cases leadership of the initiatives necessary to implement the RTP. There will be at least four main streams of activity in the implementation framework:

- land use coordination;
- operational and institutional collaboration;
- government involvement; and
- travel behaviour.

Land Use Coordination – The RTP will include an ambitious program for new transportation facilities which must be supported by a compatible pattern of development and land use. The Growth Plan provides the basic land use framework, and in implementing the Growth Plan, regional and municipal planning policies must ensure the most efficient distribution of people and jobs from a transportation perspective. Such municipal planning decisions must recognize the imperatives of the RTP — the mechanisms needed to ensure this will need to be detailed as the RTP moves forward. They may include a planning role for Metrolinx, status for the RTP in the planning process, an enhanced provincial interest in key projects that could affect the viability of the transportation system, or leading by example through demonstration projects and best practice guidelines.

Operational and Institutional Collaboration – The RTP will provide important direction to the entities that deliver our daily transportation services. It will encourage the removal of operational and regulatory barriers to promote more efficient, cost-effective service, and allow operators and agencies to make more informed long-term investment decisions. Agencies will also be valuable partners in accelerating supportive land use projects such as transit station improvements or *mobility hub* development. Mechanisms will be needed to ensure that these decisions and undertakings are consistent with the directions in the RTP.

Government Involvement – Having set out a long-term plan for the future growth of the broader region under the Growth Plan, the province will play an important role in advancing many aspects of the RTP. Provincial ministries can provide access to legislative and fiscal tools that will assist in the implementation of the Plan. The RTP will provide the

Government of Ontario with a set of priorities to inform and guide its budgetary decisions. The federal government will also play a role in supporting the RTP through its regulatory authority related to airports, railways and marine systems, as well as ongoing investment in transportation infrastructure. Municipalities will play a significant role in land use planning, transportation planning, and financing. All governments will be called upon to show leadership in advancing best practices and delivering programs such as *Transportation Demand Management* and *active transportation* measures. With over 30 governments and agencies having influence over transportation and land use in the region, decisions will need to be informed by, and be consistent with, the RTP.

Travel Behaviour – As the focus of the RTP, the travelling public will benefit the most from the Plan. All actions of the Plan will be geared towards improving the experience of the traveller through the delivery of more and better services, greater choices, as well as incentives, information and programs. The RTP will bring greater choice to all travellers. The success of the RTP will depend on how individual citizens respond to these new opportunities and change their travel behaviours.

5.3 Investment Strategy

Metrolinx is developing, in tandem with the RTP, an Investment Strategy that is a sustainable financing plan for implementation, including a life-cycle approach to:

- expansion;
- optimization and renewal; and
- operations.

The Investment Strategy has as its principles:

- a shared responsibility by all three levels of government;
- access to a broad range of financing tools and revenue sources;
- dedicated funding pledged back to support life-cycle expansion, renewal, maintenance and operating needs;
- flexibility to fund integrated, multi-modal alternatives;
- the need to address the true costs of transportation, including external economic, environmental and social costs;
- private-sector participation, conditional on public control, public interest and transparency;
- the need to support GHG emissions reduction, renewable energy, stronger communities and improved public health;
- broad engagement of citizens and transportation customers in strategy development; and
- a commitment to performance measurement, public reporting and accountability.

The Investment Strategy will identify criteria to evaluate the effectiveness of the proposed financing tools and revenue sources to meet Metrolinx's objectives for an integrated, sustainable transportation system for the *GTHA*.

6 Next Steps

The directions listed in Section 2, the test concepts described in Section 3, the performance/cost comparison of those test concepts described in Section 4, and the brief discussion of plan implementation issues in Section 5 are presented in this White Paper as a basis for discussion, review and comment by stakeholders and the public. This feedback will inform the development of the Draft RTP which will be released for consultation in late July 2008.

A final RTP will be released in Fall 2008.

You can send your comments on this paper to:

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You can also participate in our online consultations at www.metrolinx.com.

For copies of this paper, please visit our website or call Metrolinx at 416-874-5900.

Appendix A: Glossary of Terms

The glossary is intended to clarify the meaning of terms used in White Papers 1 and 2.

- **Active Transportation** – non-motorized travel, including walking, cycling, roller-blading and wheelchair movements: see Green Paper 3. The active transportation network includes sidewalks, crosswalks, designated road lanes and off-road trails to accommodate active transportation.

- **Arterial Road** – a high-volume urban road with at least four lanes, having a typical speed limit of 50 to 60 km/h and typical spacing between traffic signals of 200 to 400 metres. Its typical volume is less than 20,000 vehicles/day and it connects to collector roads, other arterial roads and expressways.

- **Bus Rapid Transit (BRT)** – similar to light rail transit (see entry below) operating on protected rights-of-way, but using advanced bus technology and station/vehicle features to improve passenger comfort and convenience. Capacity of up to 10,000 people per hour, peak direction. Average speed: 15 to 30 km/h in mixed traffic; 30 to 40 km/h in separate right-of-way depending on station spacing. Example: Vancouver 98B Line (Richmond section).

- **Commuter Rail/GO Rail** – diesel-electric trains operating on existing rail lines, as in the current GO Transit rail network; approximate realistic capacity at 10-minute headways of 9,000 to 10,000 persons per hour peak direction (pphpd); higher capacities (up to 15,000 pphpd) could be achieved by using higher frequencies; service could be enhanced by electrification, enabling better train performance (acceleration) and therefore higher average speeds even with relatively close station spacing. Average speed: 60 km/h with 2 km station spacing; 80 km/h with wider station spacing or electrified trains. Example: GO Transit rail system.

- **Controlled-Access Highway** – a high-speed, high-capacity highway with at least four lanes and grade-separated with access to the facility limited to ramps and interchanges. May include signalized intersections. Typical speed limit of 60 to 90 km/h with daily traffic greater than 20,000 vehicles.

- **Density** – the ratio of residents or jobs per unit of land area.

- **Expressway** – similar to a controlled access highway, but typically serving commuter traffic within a single city or municipality; may allow access from adjacent properties; may also include signalized intersections. The speed limit is typically 60 to 90 km/h with daily traffic greater than 20,000 vehicles.

- **Greater Golden Horseshoe** – the geographic area designated as the Greater Golden Horseshoe growth plan area in Ontario Regulation 416/05.

- **Greater Toronto and Hamilton Area (GTHA)** – the metropolitan region encompassing the City of Toronto, the four surrounding Regional Municipalities (Durham, Halton, Peel and York) and the City of Hamilton.

- **Headway** – the scheduled time between successive transit vehicles on a given route.

- **High Occupancy Vehicle (HOV) Lane** – a roadway lane designated for use only by vehicles with a specified minimum number of occupants, usually two or three; see Green Paper 6.

- **Higher-Order Transit** – includes all forms of rapid transit (see definition below). The term High-Order Transit is often used interchangeably.

- **Intelligent Transportation System (ITS)** – use of real-time computer/communications/information technology for advanced, traffic-responsive, area-wide traffic control and to provide information which allows transportation

providers to optimize transportation system operations and enables travellers to use the system more efficiently and effectively, while also increasing their convenience and ease of travelling.

- **LEED (Leadership in Energy and Environmental Design)** – a green building rating system, since expanded to rate neighbourhood development. Buildings can qualify for four levels of certification related to environmentally sustainable construction. Certification is granted by the Green Building Council based on an application documenting compliance with the rating system requirements, as well as paying registration and certification fees.

- **Light Rail Transit (LRT)** – streetcar trains (up to three or four cars per train) operating on protected rights-of-way adjacent to or in the medians of roadways or rail rights-of-way with at-grade intersections, possibly with some sections operating in mixed-traffic and/or in tunnels. Electric power is normally via an overhead trolley or pantograph. Capacity of up to 15,000 passengers per hour per direction, with even higher capacities on completely segregated rights-of-way. Average speed: 15 to 30 km/h in mixed traffic; 30 to 40 km/h on separate right-of-way depending on station spacing. Example: Calgary LRT system.

- **Major Transit Station Areas** – the area including and around any existing or planned higher-order transit station within a settlement area, or the area including and around a major bus depot in a urban core. Station areas generally are defined as the area within an approximate 500 m radius of a transit station, representing about a 10-minute walk. [Source: Ministry of Public Infrastructure Renewal, *Growth Plan for the Greater Golden Horseshoe, 2006*.]

- **Major Trip Generator** – a facility or area which generates significant volumes of passenger and/or goods/services trips to/from residential, commercial and/or industrial land uses.

- **Metro** – electrified trains operating below or at-grade with separated rights-of-way; capacity in the range of 35,000 to 40,000 passengers per hour per direction. Average speed: 25 km/h with 0.5 to 1 km station spacing; 40 km/h with 2 km station spacing. Also referred to as heavy rail transit (HRT). Example: Toronto subway system.

- **Mobility Hub** – a place of connectivity where different modes of transportation, from walking to high-speed rail, come together seamlessly and where there is an attractive, intensive concentration of employment, living, shopping and enjoyment around a major transit station: see Green Paper 2 and sections 2.2 and 3.3 of White Paper 2.

- **Modal Split** – the proportion of total person trips using each of the various different modes of transportation. The proportion using any one mode is its modal share.

- **Naked Streets** – streets in which traffic direction signs/controls have been modified or eliminated to force vehicular traffic to move cautiously and more slowly.

- **Paratransit** – small vehicles including buses, jitneys, vans and taxis, operating on fixed routes with deviation or independent of routes (e.g. group taxi service), and typically without fixed schedules. Passengers are usually picked up and dropped off at request.

- **Queue-Jump Lanes** – short roadway lanes provided on the approaches to signalized intersections which allow buses or cyclists to by-pass queued traffic and enter the intersection before other traffic when the traffic light turns green.

- **Rapid Transit** – transit service separated partially or completely from general vehicular traffic and therefore able to maintain higher levels of speed, reliability and vehicle productivity than can be achieved by transit vehicles operating in mixed traffic.

- **Regional Express** – high-speed electric trains, similar to Metro, but with wider station spacing to effectively serve longer-distance regional trips. Regional Express could have a capacity of approximately 60,000 passengers per hour

in the peak direction (pphpd) with trains operating in completely separated rights-of-way. Average speed: 80 km/h with 4 to 6 km station spacing. Example: Paris Réseau Express Regional (RER).

- **Settlement Areas** – urban and rural settlement areas within municipalities (such as cities, towns, villages and hamlets) where: a) development is concentrated and which have a mix of land uses; and b) lands have been designated in an official plan for development over the long term planning horizon provided for in the Provincial Policy Statement, 2005. Where there are no lands that have been designated over the long-term, the settlement area may be no larger than the area where development is concentrated. [Source: Ministry of Public Infrastructure Renewal, *Growth Plan for the Greater Golden Horseshoe, 2006.*]

- **Short Sea Shipping** – port-to-port goods movement on the Great Lakes. In the RTP context, these would likely be mainly among ports serving the *GTHA* or between these ports and transfer points to/from ocean-going vessels downstream from the St. Lawrence Seaway: see Green Paper 5.

- **Streetcars** – urban rail vehicles circulating at low speeds (e.g. 10 to 25 km/h) in mixed traffic, with closely spaced stops (e.g. 200 metres). Examples exist in Toronto and Portland, Oregon.

- **Surface Transit** – buses, trolley buses or streetcars operating typically in mixed traffic using standard and articulated diesel buses or electric propulsion. Capacity of up to 2,000 passengers per hour per direction. Average speed of 10 to 25 km/h.

- **Transit Catchment Area** - the area around each transit station that contains most origins (e.g. home) and destinations (e.g. work or school) for transit users. The catchment area varies by the type of transit being accessed, the means by which it is being accessed, and by the surrounding urban fabric. For example, a downtown subway station will have a different-sized catchment area for a pedestrian than would a suburban GO train station.

- **Transit Service Standards** – standards specifying performance levels such as scheduled travel speeds, service headways, route spacing/coverage, station spacing, and vehicle loading.

- **Transitway** – buses operating on exclusive two-lane busways. Capacity of 10,000 passengers per hour per direction. Average speed: 40-80 km/h depending on stop spacing. Example: Ottawa Transitway system, average speed of 40 to 60 km/h.

- **Transportation Demand Management (TDM)** – a program of incentives which influence whether, when, where and how people travel, and encourage them to make more efficient use of the transportation system: see Green Paper 4.

- **Transportation Hierarchy** – the priority order in which transportation directions and modes will be considered and given precedence in planning, designing, funding and operating a transportation system.

- **Urban Growth Centres (UGCs)** – centres designated in the provincial *Growth Plan for the Greater Golden Horseshoe, 2006*. The Growth Plan designates 25 UGCs in the *Greater Golden Horseshoe*, of which 17 are in the *GTHA*.

Appendix B: MoveOntario 2020 Projects

GO Transit Commuter Rail

1. GO Lakeshore West rail line capacity expansion by adding a third track from Port Credit to Oakville
2. GO Lakeshore West rail line capacity expansion by adding a third track from Burlington to Hamilton
3. GO Lakeshore East rail line capacity expansion by adding a third track from Union Station to Scarborough
4. GO Lakeshore East rail line extension from Oshawa to Bowmanville
5. GO Lakeshore rail line electrification (SuperGO)
6. GO Milton rail line capacity expansion from Union Station to Milton
7. GO Georgetown rail line capacity expansion from Union Station to Georgetown
8. GO Bradford rail line capacity expansion from Union Station to Bradford
9. GO Bradford rail line extension and capacity expansion from Bradford to Barrie
10. GO Richmond Hill rail line capacity expansion from Union Station to Richmond Hill
11. GO Richmond Hill rail line extension to Aurora Road
12. GO Stouffville rail line capacity expansion from Union Station to Stouffville and extension of the line to Uxbridge
13. New GO Crosstown rail line between Weston Road and the Don Valley
14. New GO Crosstown rail line between the Don Valley and Agincourt
15. New GO rail line from Union Station to Bolton
16. New GO rail line on the Havelock line from Agincourt to Pickering
17. New GO rail line on the Seaton line from Agincourt to Brock Road in Pickering

GO Bus Rapid Transit (BRT)

18. GO Bus Rapid Transit along Highway 403 from Oakville GO rail station to Mississauga
19. Mississauga Transitway west of Mississauga City Centre to Winston Churchill Boulevard
20. Mississauga Transitway east of Mississauga City Centre to Renforth Drive
21. GO Bus Rapid Transit northwest Toronto link from Renforth Drive to York University
22. GO Bus Rapid Transit on Markham Road from Highway 407 in Markham to Highway 401
23. GO Bus Rapid Transit on Highway 401 from Markham Road in Scarborough to Pickering GO rail station
24. GO Bus Rapid Transit connector on Highway 427 from Renforth Drive to Highway 407
25. GO Bus Rapid Transit along Highway 407 from York University to Langstaff (Yonge Street) and on to Markham Road

26. GO Bus Rapid Transit along Highway 407 from Burlington to Highway 401

27. GO Bus Rapid Transit along Highway 407 from Highway 401 to Highway 427

28. GO Bus Rapid Transit along Highway 407 from Highway 427 to York University

Subway and Other Rapid Transit

29. Yonge subway line extension north from Finch station to Highway 7 (Langstaff)

30. VIVA Markham North-South Link from Markham Centre to Don Mills station

31. Pearson Air-Rail link to Union Station

32. Hamilton east-west rapid transit on King/Main Streets from Eastgate Mall to McMaster University

33. Hamilton north-south rapid transit on James/Upper James Streets from Rymal Road to King Street

34. Brampton Acceleride on Queen Street from Main Street to Highway 50

35. Hurontario Light Rail Transit from Queen Street in Brampton to Lakeshore Road in Mississauga

36. Eglinton Avenue Light Rail Transit from Renforth Drive to Kennedy Road in Scarborough

37. Yonge Bus Rapid Transit busway from Finch station to Steeles Avenue

38. Dundas Street West Light Rail Transit from Kipling station to Hurontario Street

39. Scarborough RT extension from McCowan station to Sheppard Avenue

40. Sheppard Avenue Light Rail Transit from Don Mills Road to Morningside Avenue

41. Finch Avenue West Light Rail Transit from Highway 27 to Yonge Street

42. Don Mills Road Light Rail Transit from Steeles Avenue to the Bloor-Danforth subway

43. Jane Street Light Rail Transit from Steeles Avenue to Jane station on the Bloor-Danforth subway

44. Malvern Light Rail Transit from Kennedy station to Malvern

45. Waterfront West Light Rail Transit from Union Station to Long Branch

46. VIVA Yonge Street from Steeles Avenue to Highway 7 (Langstaff)

47. VIVA Yonge Street from Highway 7 (Langstaff) to 19th Avenue in Richmond Hill

48. VIVA Yonge Street from 19th Avenue to Newmarket

49. VIVA Highway 7 from Highway 50 to Yonge Street (Langstaff)

50. VIVA Highway 7 from Yonge Street (Langstaff) to Cornell

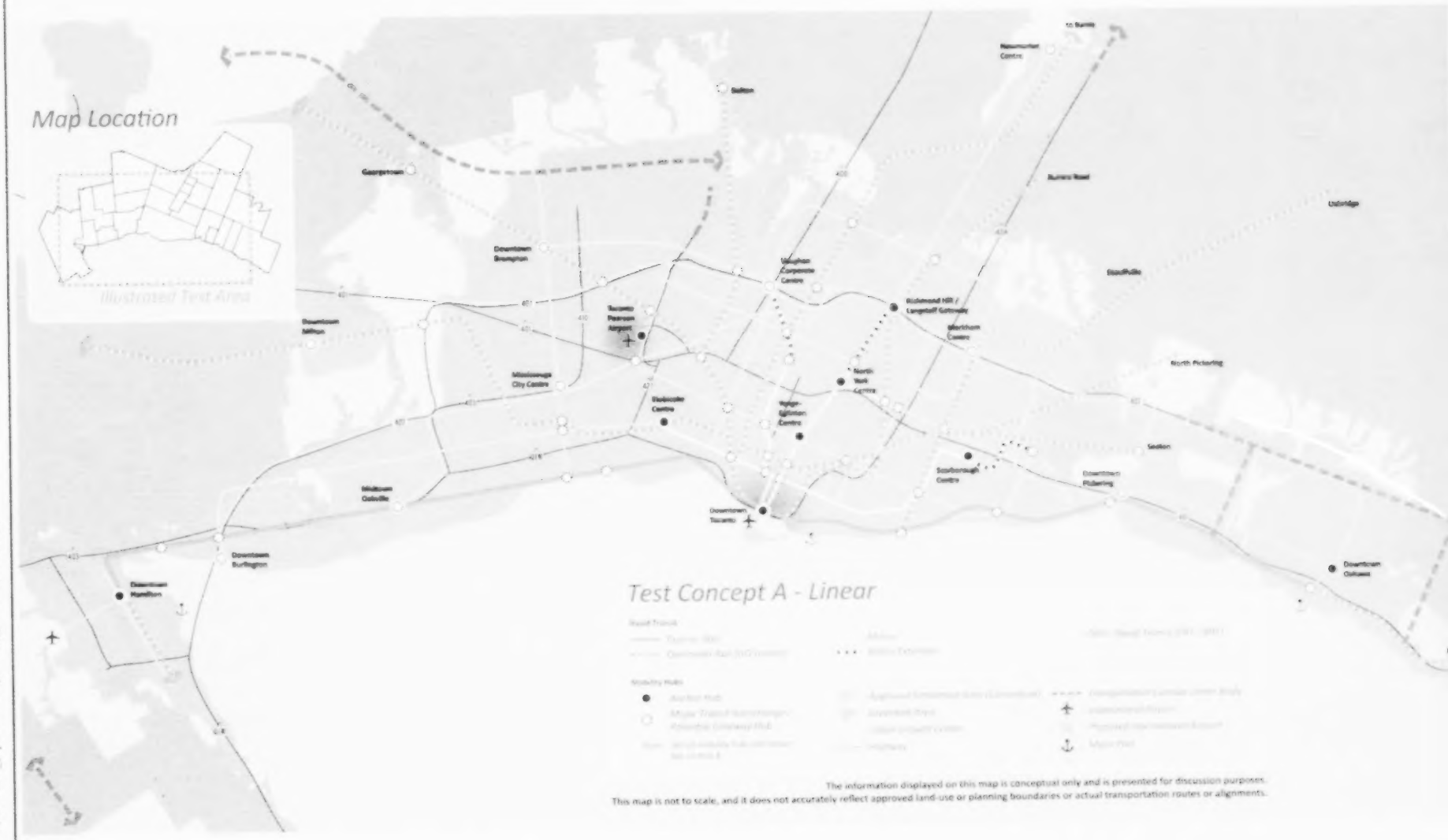
51. Durham rapid transit line on Highway 2 from Oshawa to Pickering

52. Spadina subway line extension north from Downsview station to Highway 7 (Vaughan Corporate Centre)

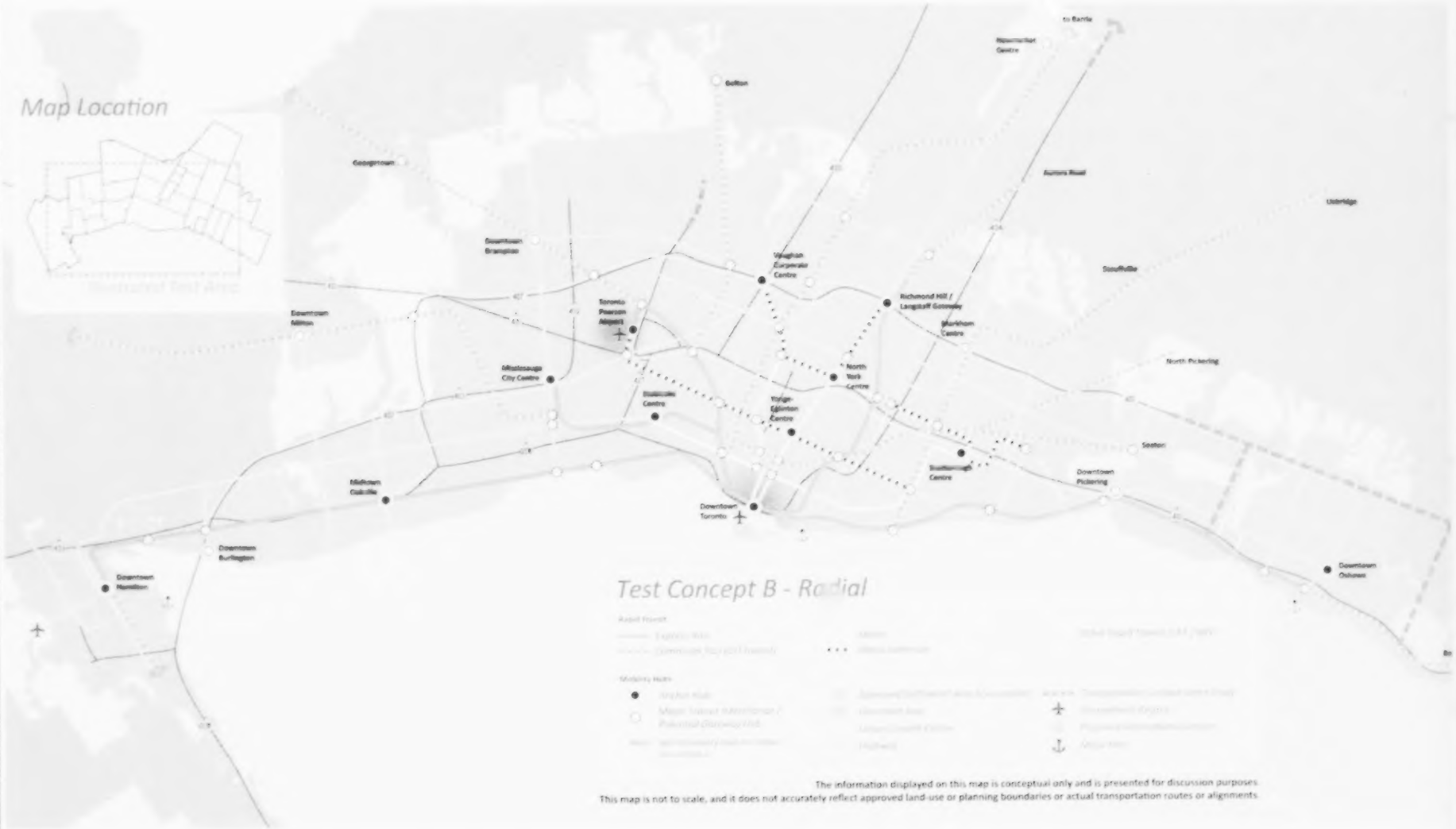
Appendix C: Maps of Existing Infrastructure and the Test Concepts

Map C-1: Existing Infrastructure

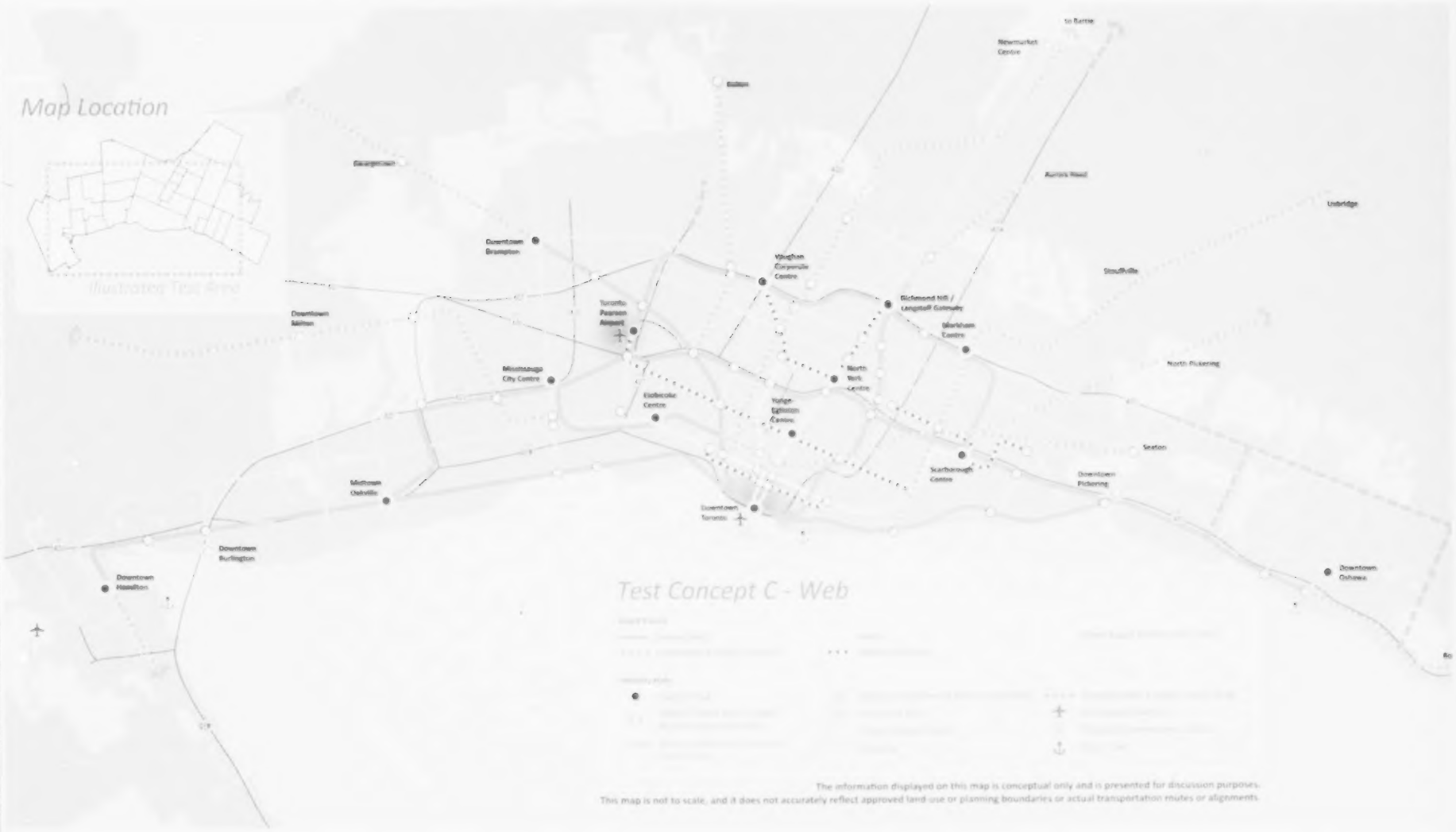
Map C-2: Test Concept A - Linear


Map Location
Illustrated Test Area
Test Concept A - Linear
The information displayed on this map is conceptual only and is presented for discussion purposes.
This map is not to scale, and it does not accurately reflect approved land-use or planning boundaries or actual transportation routes or alignments.

Map C-3: Test Concept B - Radial



Map C-4: Test Concept C - Web



Appendix D: Test Concept Preliminary Results

Performance estimates for the morning peak period (6 a.m. to 9 a.m.) of a typical workday in the year 2031 are forecast in the following three tables, showing comparisons among the Business-As-Usual (BAU) Test Concept and each of Test Concepts A, B and C. The indicators used in the tables relate to the goals described in White Paper 1, as follows:

Table D-1 A Great Quality of Life for People

Table D-2 A Thriving, Healthy and Protected Environment

Table D-3 A Strong Prosperous and Competitive Economy

Representative objectives and indicators are shown in each table.

Table D-1 A Great Quality of Life for People

		Test Concept Performance in 2031			
	2006	BAU	Test Concept A - Linear	Test Concept B - Radial	Test Concept C - Web
OBJECTIVES: Improved transportation experience and travel time; less crowding on transit; increased transportation options for accessing a range of destinations					
Transit trips by destination region in the morning peak period					
Toronto:	398,000	591,100	701,000	769,400	826,300
Durham:	8,600	21,800	31,500	34,400	41,600
York:	14,600	50,900	71,000	87,200	105,900
Peel:	25,600	58,300	81,000	103,000	140,300
Halton:	4,300	15,200	22,400	34,100	43,600
Hamilton:	15,000	22,600	31,000	32,300	32,300
Total:	466,700	699,900	937,900	1,060,400	1,190,000
Transit *modal split*					
Transit:	16.5%	17.0%	23.0%	26.0%	29.0%
Percent of commuters who can get to work within 45 minutes via transit, auto					
Transit:	38%	39-43%	44-48%	50-54%	52-56%
Auto:	60%	58-62%	58-62%	59-63%	57-61%
Percent of population within 500m, 1 km, 2 km and 5km of *rapid transit*					
0.5 km:	11%	13%	25%	30%	35%
1 km:	25%	28%	47%	57%	62%
2 km:	52%	51%	70%	81%	82%
5 km:	89%	81%	89%	93%	94%
Increased transit service capacity (millions of seat-km)					
***Regional Express*:**	n/a	n/a	17.1	31.0	41.0
***Commuter Rail*:**	2.5	9.9	12.2	24.2	28.5
***Metro*:**	2.3	3.0	4.5	8.7	8.7
Other *Rapid Transit*:	0.07	0.33	1.5	3.2	4.5
Surface Transit:	3.2	4.7	6.0	6.5	6.6
OBJECTIVE: Decreased need for vehicular travel, particularly over long distances and at rush hour					
Vehicle kilometres of travel (millions of VKT for a.m. peak hours)	14.7	18.1	17.9	17.3	16.9
Peak hour vehicle kilometres of travel per capita (km/person)	2.45	2.10	2.08	2.01	1.97
Morning peak period auto trips	2,068,000	2,912,000	2,736,000	2,594,000	2,436,000
Average home-based work trip length (km)	15.2	15.2	15.0	16.3	17.7
OBJECTIVES: Improved walking and cycling amenities; more transit- and pedestrian-friendly streetscapes					
Active transportation modal split	9%	9%	9.5%	10%	10.5%

Table D-2 A Thriving, Healthy and Protected Environment

		Test Concept Performance in 2031			
	2006	BAU	Test Concept A - Linear	Test Concept B - Radial	Test Concept C - Web
OBJECTIVES: Decreased use of non-renewable resources; increased recycling rate of construction materials and vehicles					
Total annual fuel and electricity consumption					
Auto (billion Litres):	4.54	5.60	5.54	5.35	5.16
Auto (million Gigajoules):	158 M	195	193	186	179
Transit (million Gigajoules):	9.55	9.91	11.36	11.65	15.11
OBJECTIVE: Reduced and stabilized transportation-related GHG emissions					
Auto GHG emission levels					
Total (million tonnes/year):	14.1	16.5 – 18.3	15.4 – 18.0	14.1 – 17.4	12.8 – 16.8
Tonnes per capita per year:	2.35	1.92 – 2.12	1.79 – 2.09	1.64 – 2.03	1.49 – 1.95
Auto GHG emissions levels (kg GHG per person-km)	0.22	0.20 – 0.24	0.18 – 0.21	0.16 – 0.20	0.14 – 0.19
OBJECTIVE: Improved air quality					
Total common air pollutant emissions by auto (million kg/year)					
CO:	474	329	327	315	308
NOx:	25.15	7.05	7.01	6.75	6.6
SOx:	0.174	0.204	0.203	0.195	0.191
VOCs:	28.0	11.0	10.9	10.5	10.3
PM10:	0.691	0.912	0.907	0.873	0.854
PM2.5:	0.335	0.403	0.40	0.385	0.377
Total common air pollutant emissions by auto per person-km (grams)					
CO:	7.43	4.02	3.90	3.66	3.52
NOx:	0.39	0.09	0.08	0.08	0.08
SOx:	0.003	0.003	0.002	0.002	0.002
VOCs:	0.44	0.13	0.13	0.12	0.12
PM10:	0.011	0.011	0.011	0.01	0.01
PM2.5:	0.005	0.005	0.005	0.005	0.004

Table D-3 A Strong Prosperous and Competitive Economy

		Test Concept Performance in 2031			
	2006	BAU	Test Concept A - Linear	Test Concept B - Radial	Test Concept C - Web
OBJECTIVE: Lower average trip time for people and goods					
Average vehicle speed, auto and *rapid transit*(km/h)					
Auto:	48	38	43	45	44
***Rapid Transit*:**	29	28	29	30	31
Travel times for selected major origin-destination pairs (min)					
Richmond Hill-Downtown Toronto:	Auto: 49 Transit:73	Auto: 53 Transit: 66	Auto: 50 Transit: 56	Auto: 48 Transit: 36	Auto: 44 Transit: 36
Square One-Vaughan Corporate Centre:	Auto: 44 Transit: 82	Auto: 45 Transit: 81	Auto: 42 Transit: 74	Auto: 43 Transit: 68	Auto: 40 Transit: 44
Pickering-Markham:	Auto: 37 Transit: 89	Auto: 48 Transit: 89	Auto: 44 Transit: 71	Auto: 43 Transit: 58	Auto: 42 Transit: 45
Scarborough-Etobicoke:	Auto: 55 Transit: 75	Auto: 59 Transit: 75	Auto: 58 Transit: 69	Auto: 57 Transit: 64	Auto: 54 Transit: 64
Airport-Downtown Toronto:	Auto: 43 Transit: 79	Auto: 47 Transit: 77	Auto: 45 Transit: 58	Auto: 45 Transit: 40	Auto: 44 Transit: 39
OBJECTIVE: Managed congestion					
Total hours of delay (autos)	42,700	84,500	62,000	54,000	50,000
Congestion costs (billions of dollars per year)	2.2	4.2	3.1	2.7	2.5
OBJECTIVE: Transparent and fairly allocated passenger transportation costs, across modes					
Average user transportation costs per year (2006 dollars)					
Transit Rider:	1,410	1,460	1,450	1,500	1,490
Auto Driver:	9,300	10,800	18,200	18,700	18,900
Average User:	7,900	9,000	13,900	13,700	13,200
Total transportation capital costs for 2006 – 2031 expansion vs. transit riders roads, transit (billions of 2006 dollars)					
Transit Capital Costs:	-	5	40	60	80
Road Capital Costs:	-	15	20	15	15
Total:	-	20	60	75	95
Total transportation operating costs (billions of 2006 dollars per year)					
Transit:	1.6	2.1	2.6	3.3	3.8

Appendix E: Test Concept Preliminary Sensitivity Testing – Impact of Road Capacity on System Performance

Introduction

The three test concepts described in sections 3 and 4 of this paper were presented to test how the transportation system might be expected to perform under different configurations of transit and road infrastructure. There are, of course, numerous additional configurations and combinations that could be considered. Prior to developing the Draft Regional Transportation Plan, Metrolinx will undertake sensitivity testing to examine how the transportation system might be expected to perform if certain key assumptions are varied, such as the cost of driving (e.g. gas prices, parking costs, road tolling), availability of *active transportation* infrastructure, land use changes and changes in road capacity.

In this appendix, the sensitivity of the transportation system to changes in road capacity is examined. To test the impact of enhanced or diminished road capacity on the performance of the transportation system, Metrolinx modelled variations of the Radial Test Concept B and the Web Test Concept C. The results of this modelling are presented here.

Road projects have been included or excluded in this sensitivity analysis without prejudice to the formal planning and consultation processes that any such project would be required to undergo. As with the test concepts themselves, the sensitivity analysis presented here is provided for discussion only, and should not be construed as recommendations.

In some cases, road infrastructure that has already received various stages of approval, such as Environmental Assessment approval, has been removed from the modelling. In other cases, road infrastructure has been included that has not been approved under the *Environmental Assessment Act* or other approvals processes.

It is important to note that the *Greater Toronto Transportation Authority Act* requires the RTP to conform to the *Growth Plan for the Greater Golden Horseshoe, 2006*. Some of the transportation infrastructure modelled here would not conform with the Growth Plan. They are modelled solely for the purpose of providing insight into the impact of road infrastructure on the transportation system.

Description of the Concepts

Test Concept B2 - Radial System with Expanded Roads

Test Concept B2 examines the impact of expanded road capacity on the performance of the transportation system. This test builds on Radial Test Concept B described in section 3. It includes identical *rapid transit* infrastructure, with the following additional road and highway improvements:

- GTA-West proposed travel corridor linking Highway 400 to the Guelph area
- Niagara-GTA corridor
- Bradford Bypass from Highway 400 to Highway 404
- Highway 410 extension north to the GTA-West transportation corridor
- Highway 404 extension north to Highway 12
- Highway 427 extension north to the GTA-West transportation corridor

Test Concept B2 also assumes a 10 per cent increase in the *arterial road* capacity in Durham, York, Halton and Peel Regions, reflecting an aggressive road widening program in these municipalities beyond what is currently planned. This assumption is applied generally across these municipalities, not specifically to individual corridors.

Test Concept B2 assumes the land use characteristics of Linear Test Concept A since the high intensification level of Radial Test Concept B may not be achievable with the greater emphasis on roads assumed in this test. It is also assumed that planned *HOV* lanes are constructed as general-purpose, or mixed-traffic lanes.

Test Concept C2 – Web System with Reduced Roads

Test Concept C2 examines the impact of reduced road and highway capacity on the performance of the transportation system. This test builds on Web Test Concept C described in section 3. It includes identical *rapid transit* infrastructure as Test Concept C, with the following road and highway infrastructure excluded:

- Programmed improvements, as documented in MTO's capital program and in municipal Transportation Master Plans
- Highway 407 East extension
- Extensions to Highway 404 and Highway 427 as defined in the *Growth Plan for the Greater Golden Horseshoe*

Preliminary Results of Sensitivity Testing

Costs

Expanding road capacity has a significant effect on the capital cost for the transportation system, and a moderate effect on transit operating costs, as shown in Table E-1.

The introduction of new road capacity in Test Concept B2 increases capital costs by $10 billion to a total of $85 billion. This does not reflect the additional cost of maintenance and operating costs for the additional road capacity. Removing road capacity in Test Concept C2 decreases capital costs by $15 billion relative to Test Concept C.

Annual transit operating costs are slightly lower with expanded road capacity reflecting the lower levels of local transit service needed to serve the forecasted lower transit ridership in Test Concept B2. Transit operating costs increase slightly to service the higher ridership that results when road capacity is reduced in Test Concept C2. The decline in ridership as additional road capacity is introduced would also lead to lower fare revenues. This would mean higher levels of operating subsidies would be necessary to maintain the same level of transit service. Conversely, the high ridership in Test Concept C2 may lead to a higher cost recovery ratio.

Expanding road capacity results in the highest costs to auto drivers and all transportation users, due to increases in the number and length of trips. This cost increase amounts to over $5 billion per year more in Test Concept B2 compared to Test Concept B.

Table E-1 Cost Implications of Changes in Road Capacity

	Test Concept B - Radial	Test Concept B2 - Radial With Expanded Roads	Test Concept C - Web	Test Concept C2 - Web With Reduced Roads
Average annual user transportation costs in year 2031(in 2006 dollars per year):				
Transit Rider:	1,500	1,550	1,490	1,490
Auto Driver:	18,700	19,400	18,900	18,800
Average User:	13,700	14,600	13,200	13,000
Order of magnitude capital cost estimates (billions of 2006 dollars):				
Transit Capital Costs:	60	60	80	80
Road Capital Costs:	15	25	15	0
Total:	75	85	95	80
Annual [i]:	3.0	3.4	3.8	3.2
Total transit operating costs (in billions of 2006 dollars per year)	3.3	3.1	3.8	3.9

i. Annual cost assumes a 25-year investment period.

Transit Ridership and *Modal Split*

The transit system was not varied between Test Concepts B and B2 or between Test Concepts C and C2. However, changes in road capacity affect the ridership and *modal splits* achieved by the transit system, as shown in Table E-2.

Expanding road capacity results in declining transit ridership. Test Concept B2 includes the same *rapid transit* infrastructure as Test Concept B, yet has seven per cent fewer transit trips in the morning rush hour, indicating that the transit infrastructure is used less efficiently. Transit *modal split* drops from 26 per cent to 24.5 per cent region-wide. This decrease is relatively small since all road improvements happen outside of the City of Toronto, leaving transit use unaffected to Toronto where ridership is by far the highest. The drop in *modal split* is much higher outside of Toronto. Transit trips in the morning peak period to York Region decrease by 30 per cent, to Halton by 23 per cent, to Peel by 28 per cent, to Hamilton by 12 per cent, and to Durham by 16 per cent.

Reducing road capacity in Test Concept C2 increases transit ridership slightly relative to Test Concept C, ranging from a negligible increase in some municipalities to as high as four per cent in York Region.

The implications of expanded or reduced road capacity on *active transportation* have not been considered in this modelling. More efficient roads may encourage driving at the expense of walking and cycling. Wider roads may also make it less comfortable to walk or cycle. However, expanded road construction programs may provide the opportunity to build sidewalks and bike lanes. Conversely, although a freeze in road construction may encourage cycling, additional congestion and heavier traffic may also work against these objectives.

Table E-2 Implications of Road Capacity on Transit Ridership

	Test Concept B - Radial	Test Concept B2 - Radial With Expanded Roads	Test Concept C - Web	Test Concept C2 - Web With Reduced Roads
Transit trips by destination region in the morning peak period				
Toronto:	769,400	769,900	826,300	847,600
Durham:	34,400	29,000	41,600	42,000
York:	87,200	61,100	105,900	110,600
Peel:	103,000	74,300	140,300	141,500
Halton:	34,100	26,400	43,600	44,400
Hamilton:	32,300	28,300	32,300	32,400
Total:	1,060,400	989,000	1,190,000	1,218,500
Transit modal share by destination region in the morning peak period				
Toronto:	47.3%	47.3%	51.7%	53.0%
Durham:	10.8%	8.2%	11.8%	11.9%
York:	12.8%	8.9%	14.9%	15.5%
Peel:	13.4%	9.7%	17.7%	17.9%
Halton:	9.7%	7.5%	12.2%	12.4%
Hamilton:	11.8%	10.3%	12.7%	12.8%
Total:	26.0%	24.5%	29.0%	29.5%

Energy Use and Emissions

Changes in road capacity have a significant effect on vehicle-kilometres travelled, as expanded road capacity leads to longer and more frequent auto-based trips, as shown in Table E-3. Expanded road capacity in Test Concept B2 results in an increase in vehicle-kilometres travelled in the morning peak period of 9 per cent, which is higher than in all of the test concepts. The number of auto trips increases four per cent. In Test Concept C2, the reductions in road capacity lead to reductions in vehicle-kilometres travelled of six per cent and a slight one per cent decrease in auto trips.

Table E-3 Implications of Road Capacity on Vehicle-Kilometres Travelled

	Test Concept B - Radial	Test Concept B2 - Radial With Expanded Roads	Test Concept C - Web	Test Concept C2 - Web With Reduced Roads
Vehicle-kilometres travelled in the morning peak period (in millions)	17.3	18.9	16.9	15.9
Auto trips in the morning peak period	2,594,000	2,702,000	2,436,000	2,416,000

Changes in vehicle-kilometres travelled and auto trips have a significant impact on energy use and emissions, as shown in Table E-4. In Test Concept B2, energy use increases by 10 per cent, emissions of common air pollutants increase between 9 and 10 per cent, and GHG emissions from cars increase by 10 per cent. These figures do not include commercial vehicles and heavy trucks, which would also be expected to increase in vehicle-kilometres travelled and consequently increase energy use and emissions. As road capacity is decreased in Test Concept C2, energy use decreases by 3.4 per cent, emissions of common air pollutants decrease by as much as six per cent, and GHG emissions from cars decrease by six per cent.

Table E-4 Implications of Road Capacity on Energy Use and Emissions

	Test Concept B - Radial	Test Concept B2 - Radial With Expanded Roads	Test Concept C - Web	Test Concept C2 - Web With Reduced Roads
Total annual fuel and electricity consumption				
Auto (billion Litres):	5.35	5.89	5.16	4.85
Auto (million Gigajoules):	186	205	179	169
Transit (million Gigajoules):	11.65	12.42	15.11	16.49
Auto GHG emission levels				
Total (million tonnes/year):	14.2 - 15.7	15.6 - 17.2	12.8 - 16.8	12.0 - 15.8
Tonnes Per Capita per Year:	1.65 - 1.82	1.81 - 2.00	1.49 - 1.95	1.40 - 1.83
Total common air pollutant emissions by auto (million kg/year)				
CO:	315	344	308	289
NOx:	6.75	7.38	6.60	6.21
SOx:	0.195	0.214	0.191	0.180
VOCs:	10.5	11.5	10.3	9.7
PM10:	0.873	0.955	0.854	0.804
PM2.5:	0.385	0.422	0.377	0.355

Accessibility, Speed and Congestion

Expanding road capacity while maintaining transit service levels provides better mobility for car drivers, due to increasing travelling speeds and reduced congestion, as shown in Table E-5, although the modelling does not account for any potential induced traffic demand that may result from new road capacity.

In Test Concept B2, 68 to 72 per cent of the population would be able to get to work in 45 minutes by car, compared to 59 to 63 per cent without the additional road capacity. Accessibility by transit is largely unchanged, although this does not take into account the effects of reducing local transit service levels or of the more dispersed urban form that would be expected to follow from expanded road capacity.

Reducing road capacity in Test Concept C2 results in a slight decrease in the per cent of commuters who can get to work within 45 minutes by car, but an increase in accessibility by transit.

Expanding road capacity while maintaining transit service levels provides about a nine per cent improvement in average auto speeds. Reducing road capacity reduces average auto speeds by just over 13 per cent. Some sample trips show no change in travel times as a result of changes to road capacity (e.g. Pearson Airport to Downtown Toronto). Sample cross-regional trips outside Toronto show the most significant correlation with changes in road capacity.

Congestion improves as road capacity is expanded, excluding any potential effects of induced traffic demand. Total hours of delay for cars drops 15 per cent when new road capacity is introduced in Test Concept B2, resulting in economic costs from congestion declining by $400 million per year. When road capacity is reduced in Test Concept C2, hours of delay increase 62 per cent, increasing congestion costs by $1.6 billion per year.

The modelling does not provide an estimate for the health or economic costs of car accidents, but these would be expected to increase as vehicle-kilometres travelled increase. Further analysis would be required to quantify these costs.

Table E-5 Implications of Road Capacity on Accessibility, Speed and Congestion

	Test Concept B - Radial	Test Concept B2 - Radial With Expanded Roads	Test Concept C - Web	Test Concept C2 - Web With Reduced Roads
Per cent of commuters who can get to work within 45 minutes via transit and auto				
Transit:	50-54%	50-54%	52-56%	56-60%
Auto:	59-63%	68-72%	59-63%	57-61%
Average vehicle speed for auto and rapid transit (in km/h)				
Auto:	45	49	44	38
Rapid Transit:	30	30	31	31
Travel times for selected major origin-destination pairs (in minutes)				
Richmond Hill-Downtown Toronto:	Auto: 48 Transit: 36	Auto: 46 Transit: 36	Auto: 44 Transit: 36	Auto: 46 Transit: 36
Square One-Vaughan Corporate Centre:	Auto: 43 Transit: 68	Auto: 40 Transit: 68	Auto: 40 Transit: 44	Auto: 45 Transit: 44
Pickering-Markham:	Auto: 43 Transit: 58	Auto: 39 Transit: 58	Auto: 42 Transit: 45	Auto: 48 Transit: 45
Scarborough-Etobicoke:	Auto: 57 Transit: 64	Auto: 57 Transit: 64	Auto: 54 Transit: 64	Auto: 55 Transit: 64
Pearson Airport-Downtown Toronto:	Auto: 45 Transit: 40	Auto: 45 Transit: 40	Auto: 44 Transit: 39	Auto: 44 Transit: 39
Total hours of delay for autos	54,000	46,000	50,000	81,000
Congestion costs (in billions of dollars per year)	2.7	2.3	2.5	4.1

Summary of Preliminary Findings

The results of the sensitivity testing provide some useful insights into how the transportation system would be expected to respond to changes to road capacity.

- Expanding the capacity of the road system carries a significant capital cost, but provides economic benefits through reduced delays and congestion, particularly outside of Toronto. This does not include the impact of any induced traffic demand that may result from the increased road capacity. Costs to individual transportation users are higher with expanded road capacity, and lower transit ridership results in lower cost recovery.
- Expanding road capacity results in more and longer trips, which translates into higher GHG and other emissions.
- Expanding road capacity results in increased fuel consumption.
- Expanding road capacity has a significant effect on transit ridership, causing many travellers to switch from transit to driving, particularly outside of Toronto. Reduced road capacity has limited effect on transit *modal split*.

Other potential impacts would require further study to determine the extent to which changes in road capacity could affect them. For example, the changes in travel times and congestion demonstrated in this analysis could affect where and how people choose to live and work over the long term, which would have a direct impact on travel patterns. Similarly, new road capacity could open up new greenfield areas to development, dispersing population and jobs across a wider area. Likewise, the increased congestion in Test Concept C2 could affect economic investment and growth in the region. These factors are outside the scope of the sensitivity analysis presented here, but are nonetheless important to consider in a discussion of future options.

Appendix F: The Challenge of Climate Change

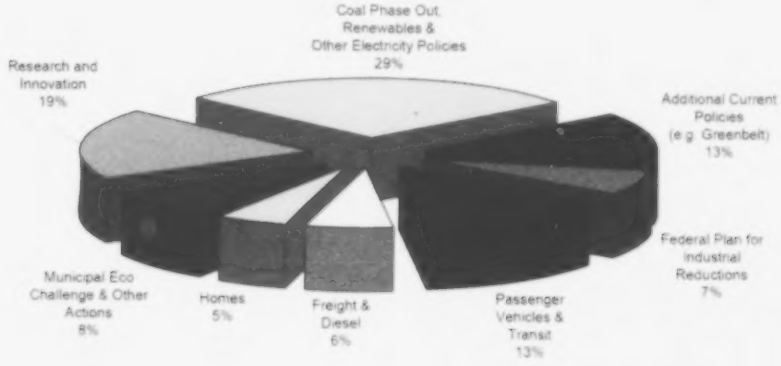
This discussion builds on the results and analysis regarding GHG emissions and climate change presented earlier in Section 4. Its purpose is to explore potential sources of reductions to meet the provincial GHG emission targets for transportation. The various approaches presented do not constitute a specific plan, but outline an ambitious set of possible approaches based on preliminary estimates. They illustrate that no "silver bullet" is available to reduce emissions, and that collaboration among businesses, governments and the public is essential for success. They will be further explored and refined in the draft RTP.

The Government of Ontario has adopted *Go Green: Ontario's Action Plan on Climate Change* which sets ambitious targets for GHG emission reductions (Figure F-1):

- By 2014: a reduction of Ontario's GHG emissions to **6 per cent** below 1990 levels (reduction of 11 megatonnes (Mt) of carbon dioxide equivalents (CO_2e) relative to 1990 levels);
- By 2020: a reduction of Ontario's GHG emissions to **15 per cent** below 1990 levels (reduction of 27 Mt of CO_2e relative to 1990 levels); and
- By 2050: a reduction of Ontario's GHG emissions to **80 per cent** below 1990 levels.

As outlined in the *Go Green* plan, the 2014 and 2020 targets will be met by a number of new policies, as well as economy-wide transformation. This requires progress in every sector, as shown in Figure F-1. The transportation sector will need to account for 19 per cent of the 2020 reductions (13 per cent for passenger vehicles and transit and six per cent for freight and diesel). Table F-1 shows how these targets and allocations translate into emission reductions by the transportation sector.

Figure F-1 Where Emission Reductions Will Have Been Achieved by 2020


Coal Phase Out, Renewables & Other Electricity Policies 29%
Research and Innovation 19%
Additional Current Policies (e.g. Greenbelt) 13%
Federal Plan for Industrial Reductions 7%
Municipal Eco Challenge & Other Actions 8%
Homes 5%
Freight & Diesel 6%
Passenger Vehicles & Transit 13%

Source: Government of Ontario, Ontario Greenhouse Gas Emissions Targets: A Technical Brief

Table F-1 Annual Reductions by 2020

	From 1990 levels
Passenger vehicles and transit	13% of 27 Mt = 3.5 Mt
Goods Movement	6% of 27 Mt = 1.6 Mt

Table F-2 shows 1990 and 2006 emissions, as well as target emissions for 2020 that have been derived for the purpose of this analysis from the *Go Green* target reductions shown in Figure F-1. Given the growth in emissions between 1990 and 2006, particularly in trucking, meeting the 2020 target will require a reduction in emissions from passenger and goods transportation in the order of 35 per cent from 2006 levels.

Table F-2 Ontario Transportation Sector GHG Emission Trends and Targets

Transport Mode	1990 Emissions (Mt CO_2e) [i]	2006 Emissions (Mt CO_2e) [ii]	2020 Target Emissions (Mt CO_2e) [iii]	Required Change 2006-2020
Total Passenger	30.7	36.9	27.1	- 26%
Total Goods Movement	13.2	22.5	11.6	- 49%
Total Passenger and Goods Movement	43.9	59.4	38.7	- 35%

i. Source: NRCan Comprehensive Energy Use Database for 1990 and 2006 values.
ii. Ibid.
iii. Estimated from emission reduction percentages for the transportation sector presented in Go Green: Ontario's Action Plan on Climate Change, August 2007, Government of Ontario.

The challenge of adding 2.6 million people to our region while trying to reduce or even hold the line on emissions should not be underestimated. It is clear that the contribution of the policies and programs described in Section 2 will be critical to achieve the reduction targets, even with ambitious infrastructure investment.

The Government of Ontario has not yet established specific targets for the *GTHA*, but based on known data on the region's emissions and provincial targets for transportation, local targets can be estimated. For the purpose of this analysis, it is assumed that the *GTHA* will aim to reduce its transportation emissions at the province-wide rate of 26 per cent from 2006 levels by 2020 for passenger travel and 49 per cent for goods movement, as shown in Table F-2.

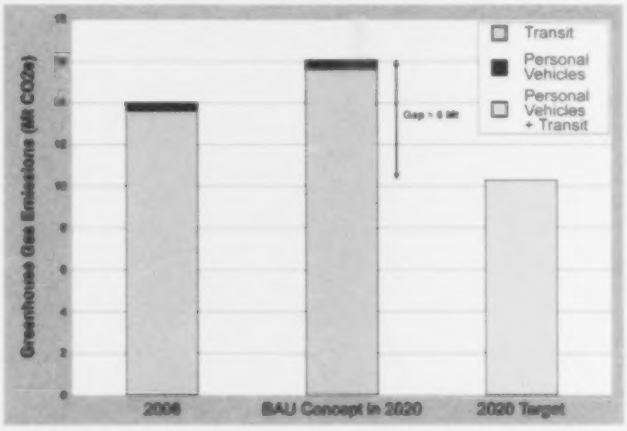
Options for the Greater Toronto and Hamilton Area

The RTP can play an important role in meeting GHG reduction targets. Opportunities for meeting the *Go Green* targets are discussed below.

Passenger Travel

Figure F-2 indicates the gap between the Business-As-Usual (BAU) Test Concept and the 2020 *Go Green* target for passenger travel. While modelling of the BAU Concept was conducted only for the year 2031, 2020 emission values were interpolated (calculated as close to the halfway mark between 2006 and 2031) to provide a means of comparison with the *Go Green* target. However, project delivery is not necessarily linear since large projects are delivered in large increments.

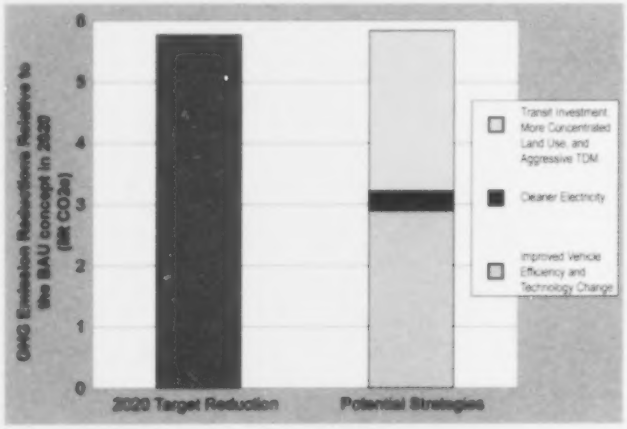
Figure F-2 GTHA Passenger Travel GHG Emissions



For the purpose of discussion, an approach towards meeting the required reductions has been determined based on the Web Test Concept C. In order to meet the 2020 target, test concepts with higher GHG emissions than those of Test Concept C would need more aggressive actions in land use, *TDM*, cleaner electricity, fuel efficiency and technological change.

The gap between the 2020 BAU emissions and the 2020 target is approximately 6 Mt. Making up this gap will require a number of ambitious strategies, as shown in Figure F-3. Please note that this value of 6 Mt is a preliminary estimate for discussion only, since regional targets have not been established and the modelling of Test Concept C has not been run specifically for the year 2020.

Figure F-3 Potential Strategies for Meeting the 2020 GHG Emission Target for Passenger Travel in the GTHA


GHG Emission Reductions Relative to the BAU concept in 2020 (Mt CO2e)
Transit Investment, More Concentrated Land Use, and Aggressive TDM
Cleaner Electricity
Improved Vehicle Efficiency and Technology Change
2020 Target Reduction
Potential Strategies

A number of potential strategies were considered. Their effects were estimated through modelling as well as benchmarking from the literature and an analysis of potential transferability to the *GTHA*.

Transit Investment, More Concentrated Land Use, and Aggressive *Transportation Demand Management*

This strategy is reflected in Test Concept C and Preliminary Directions contained in Section 2 of this report, and could entail:

- Extensive transit/transportation improvements derived from Test Concept C that could be practically implemented as of 2020, representing new *rapid transit* services brought to the doorsteps of millions more people, with expanded regional connectivity;
- An improved experience for all transit users to ensure that new and existing services are well-used;
- Land use measures building on the *Growth Plan* that encourage a greater mix of uses and higher densities to reduce the distances that people need to travel;
- Land use measures that ensure the design of our communities makes it safe, fast and convenient for people to walk, cycle and take transit;
- An aggressive package of *TDM* measures to reduce vehicle-kilometres-travelled (VKT), reduce traffic peaks, increase vehicle occupancy, encourage non-auto modes of transportation, and reduce non-essential travel. This includes extensive marketing and incentives regarding transit and carpooling, as well as some form of road pricing across the region to ensure a level playing field and encourage users to make sustainable transportation choices; and
- Measures to encourage *active transportation*.

It is important to stress again that aggressive transit investment, land use and *TDM* measures are mutually supportive; one would not be practical in the absence of the others.[1] Looking to experiences elsewhere, large behavioural changes have been observed when transit and *TDM* have been combined. For example, targeted marketing in transit corridors has achieved increases of 30 per cent in transit use in areas where the programs have been implemented.[2] In addition, research suggests that road pricing can reduce peak period travel on congested roads by up to 20 per cent.[3] Note that the modelled test concepts already include an approximate doubling of the cost of operating a personal vehicle. The strategies needed to bridge the gap between the concepts and the 2020 targets assume additional strategies to encourage alternatives to driving.

The key advantage of these initiatives is that the relevant technology is available immediately. Programs and policies to encourage higher densities and a greater mix of uses can be relatively inexpensive compared to new infrastructure and new technologies, and can reduce costs to municipalities and households. They can also be considered "no-regrets" – reduced travel distances will not only facilitate walking, cycling and transit, but will also facilitate the adoption of new technologies and compound their benefits (such as limited-range electric vehicles), creating a "virtuous circle". A more transportation-friendly urban fabric also makes walking and cycling more feasible and, in the case of transit, less costly and energy-intensive to operate.

Together, transit investment, more concentrated land use, and aggressive Transportation Demand Management could be expected to achieve about half of the targeted reductions, or about 2.6 Mt.

Cleaner Electricity

This strategy relies on cleaner sources of electricity being adopted in Ontario as part of the planned phasing out of coal-fired power plants and greater adoption of renewables and nuclear power. This will reduce the GHG emissions from subways, LRT vehicles and streetcars, as well as private plug-in hybrid electric vehicles.

Cleaner electricity could be expected to reduce GHG emissions by approximately 0.3 Mt.

1 Cansult and TSI Consultants. 2005. The Impact of Transit Improvements on GHG Emissions: A National Perspective. Transport Canada.
2 See http://www.travelsmart.vic.gov.au/
3 Victoria Transport Policy Institute, Road Pricing – Congestion Pricing, Value Pricing, Toll Roads and HOT Lanes, TDM Encyclopedia.

Improved Vehicle Efficiency and Technological Change

Vehicle efficiency and technological change can account for a significant share of the required reductions in GHG emissions. A 25 per cent improvement in the fuel efficiency of the light-duty fleet combined with a 20 per cent penetration of plug-in hybrid electric vehicles (PHEV) is assumed. Reputable studies have indicated that the technology exists and that such an improvement is reasonable by 2020, given policies to ensure the use of cost-effective technologies to increase fuel economy. [4] [5]

The additional GHG reduction from PHEVs in this strategy is contingent on the availability of cleaner electricity.

The opportunity exists for Ontario to play a leadership role in the development of transformational vehicle and fuel technologies to contribute to absolute reductions in GHG emissions from passengers vehicles in Ontario and elsewhere. It will be equally crucial to ensure through appropriate policies and programs that vehicles do not simply become more efficient but that vehicles and the entire fleet actually consume less energy. Despite technological improvements in engine efficiency over the last 30 years, vehicles now are larger, heavier and more powerful, resulting in increased fuel consumption.

Under these assumptions, improved vehicle efficiency and technological change could be expected to reduce GHG emissions by approximately 2.9 Mt.

Combined initiatives for passenger travel could be expected to reduce GHG emissions by 5.8 Mt.

Goods Movement

The goods movement analysis herein focuses on options to reduce GHG emissions from road commercial vehicles (i.e., trucking). Emissions from trucking account for approximately 89 per cent of GHG emissions from goods movement in Ontario. [6] As shown in Figure F-4, emissions from road commercial vehicles are projected to increase by approximately 44 per cent between 2006 and 2020. Given this growth, a 60 per cent reduction from projected levels is required to meet the 2020 *Go Green* target for commercial vehicles.

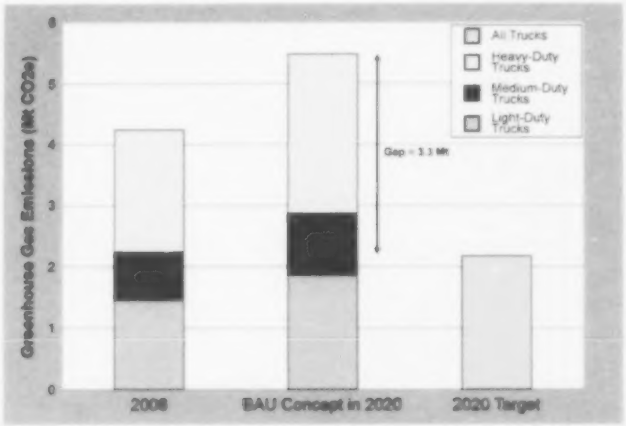
The gap between the 2020 BAU emissions and the targeted value is slightly over 3 Mt. A number of strategies are proposed to work towards meeting the target, as shown in Figure F-5. A set of ambitious strategies can make up approximately 75 per cent of the required emission reductions. More aggressive strategies are required to meet the full target.

4 Transport Canada, Environment Canada, Natural Resources Canada, Department of Finance Canada, Industry Canada, and Marbek Resource Consultants. 1998. Foundation Paper on Climate Change: Transportation Sector.

5 Greene, DL and Schafer, A. 2003. Reducing Greenhouse Gas Emissions from U.S. Transportation. Pew Center of Global Climate Change.

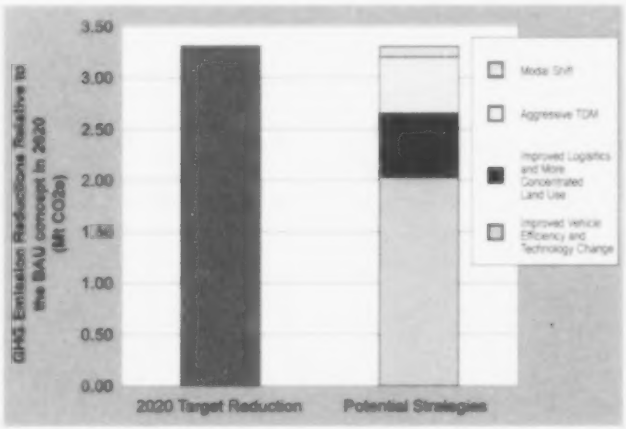
6 Natural Resources Canada, Comprehensive Energy Use Database. http://oee.nrcan.gc.ca/corporate/statistics/neud/dpa/comprehensive_tables/index.cfm?attr=0

Figure F-4 GHG Emissions from Road-Based Commercial Transport in the GTHA



Source: Based on results from Greater Golden Horseshoe Commercial Vehicles Model, IBI Group. 2006 and 2020 results are estimated by linearly interpolating between 2006 and 2031 model results. GO Green Target is based on a 49 per cent reduction from 2006 emission levels.

Figure F-5 Strategies for Reducing GHG Emissions from Road-Based Commercial Transport by 2020 in the GTHA



Modal Shift

While rail consumes about 80 per cent less energy per tonne-kilometre [7] than trucking for goods movement, there is relatively little opportunity for a substantial shift other than for long-distance freight movements. The greatest opportunity for improving the efficiency of freight transport may be to facilitate quick freight transfer between modes. This would allow for greater energy efficiency than using a single mode. [8]

A five per cent shift in heavy truck traffic to rail is assumed here. Additional shifting to *short sea shipping* (on the Great Lakes) might be achieved, but this has not yet been studied.

7 Transport Canada, Environment Canada, Natural Resources Canada, Department of Finance Canada, Industry Canada, and Marbek Resource Consultants. 1998. Foundation Paper on Climate Change: Transportation Sector.

8 Greene, DL and Schafer, A. 2003. Reducing Greenhouse Gas Emissions from U.S. Transportation. Pew Center of Global Climate Change.

Modal shift could be expected to reduce GHG emissions by approximately 0.1 Mt.

Freight-Specific *Transportation Demand Management*

In combination with rising fuel prices, some form of road or truck pricing across the region has the potential to significantly reduce truck traffic through a greater consolidation of trips or shifts to other modes, such as rail. A number of studies have estimated the price-elasticity of freight truck traffic in the range of -0.4 to -0.8, meaning that a 10 per cent increase in shipping costs would reduce truck traffic between four and eight per cent. [9] [10] [11]

A 10 per cent reduction in VKT is considered achievable given *TDM* specifically focused on goods movement. This strategy works in synergy with the 'Modal Shift' and 'Improved Logistics' strategies.

Transportation Demand Management in goods movement could be expected to reduce GHG emissions by approximately 0.5 Mt.

Improved Logistics and More Concentrated Land Use

The energy efficiency of freight logistics can be improved through changes in vehicle load factors (i.e. how much of the capacity of a truck is used during shipment), space utilization, scheduling, packaging and handling systems, and other supply-chain factors. The more concentrated land use pattern assumed for Test Concept C can also be expected to contribute to logistics improvements by reducing average trip distances for deliveries and service calls, and assisting in more efficient groupings and scheduling of such trips. There are many opportunities for improving logistics to reduce GHG emissions from trucking. For example, about 80 German cities have set up "City Logistic" projects whereby shipments are consolidated outside the city limits and better organized within the city. [12] In addition, a major UK study of freight logistics found that energy savings in the order of 25 per cent could be gained if the lowest performing two-thirds of truck fleets were to achieve the mean performance of the highest third.

In terms of fuel consumption, load factor is the most important determinant of environmental performance. Most truck fuel goes towards moving the truck rather than its payload. A half-loaded truck uses more than 90 per cent of the fuel used per kilometre by a fully loaded truck. [13] As such, opportunities to consolidate loads and use fewer trucks have significant potential to reduce GHG emissions. Approximately one-third of total truck capacity on Ontario roads is not used. [14] This value is expected to be higher for the *GTHA* given that shorter-distance trips were found to have lower-than-average load factors, particularly for private trucks (as opposed to for-hire). [15]

Given these results, improved logistics and more concentrated land use, including increasing load factors, are considered to have the potential to reduce truck kilometres travelled by at least 15 per cent and provide GHG reductions of approximately 0.5 Mt. A more aggressive logistics-improvement program could reduce *GTHA* truck-km by 25 per cent. This would be in line with the 25 per cent energy savings identified in the UK study cited above.

Improved logistics and more concentrated land use could be expected to reduce GHG emissions by approximately 0.7 Mt.

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9 Thomas Bue Bjørner (1000), "Environmental Benefits from Better Freight Transport Management: Freight Traffic in a VAR Model," Transportation Research D, Vol. 4, No. 1, January 1999, pp. 45-64.

10 James Luk and Stephen Hepburn (1993), New Review of Australian Travel Demand Elasticities, Australian Road Research Board.

11 Hagler Bailly (1999), Potential for Fuel Taxes to Reduce Greenhouse Gas Emissions from Transport, Transportation Table of the Canadian National Climate Change Process.

12 See Victoria Transport Policy Institute TDM Encyclopedia, Freight Transport Management: Increasing Commercial Vehicle Transport Efficiency. http://www.vtpi.org/tdm/tdm16.htm

13 Centre for Sustainable Transportation. 2001. Sustainable Transportation Monitor, No. 4.

14 1999 National Roadside Study

15 Centre for Sustainable Transportation. 2004. Sustainable Transportation Monitor, No. 10.

Improved Vehicle Efficiency and Technology Change

Significant improvement in truck fuel efficiency is possible by 2020. For heavy-duty vehicles, fuel-saving devices, such as aerodynamic improvements, speed limiters, and anti-idling devices, can deliver an estimated 22 per cent fuel savings in the short-term without changes to the engine. [16] Fuel efficiency for short-distance stop-and-go transport can be improved by about 50 per cent using technologies such as hybrid-electric vehicles. [17]

On the more ambitious end, the U.S. Department of Energy, in collaboration with other federal agencies and truck manufacturers and suppliers, established the 21st Century Truck program in 2000 to dramatically improve the fuel economy of trucks in the United States. With a combination of engine, aerodynamic, rolling resistance, and materials technologies, the plan calls for a 50 to 75 per cent improvement in fuel economy for light trucks, a 140 per cent improvement for medium-sized trucks, and a 60 per cent improvement for over-the-road tractor trailers. These improvements are believed to be achievable with "aggressive development and implementation of technologies currently being considered but not yet commercially viable". [18]

Based on these studies, a 30 per cent improvement in fuel efficiency across the truck fleet is considered to be an aggressive, but realistic, target. In addition to government regulations, fuel efficiency improvements will be driven by increases in fuel prices. An increase in the average truck fleet efficiency of 100 per cent instead of 30 per cent would be required to achieve the target. This improvement is similar to those targeted in the 21st Century Truck program cited above, but the challenge will be to achieve sufficient penetration of more efficient trucks into the fleet during the next 12 years. As in the case of passenger vehicle technology, incentives and disincentives will be needed to encourage and speed up the adoption of these technologies.

Improved vehicle efficiency and technology change in commercial vehicles could be expected to reduce GHG emissions by approximately 2 Mt.

Combined initiatives for Goods Movement could be expected to reduce GHG emissions by approximately 3.3 Mt.

Summary Remarks

1. Meeting greenhouse gas reduction targets will require a mix of infrastructure and policies in a variety of inter-related areas: land use; *TDM; active transportation;* pricing signals; etc. These measures assume existing technology and can be implemented immediately. Many of these measures also foster "virtuous circles". For example, influencing land use patterns to reduce the length of trips will always lead to lower costs and emissions regardless of the technology.
2. An important component of proposed GHG reduction strategies for both passengers and goods movement is improved vehicle efficiency and technology change. The challenge will be to achieve the necessary penetration of more efficient vehicles in the fleet by 2020, particularly for goods movement, because of the large GHG emissions reduction required from this source. In the short-term, it will be of crucial importance to make rapid and immediate moves towards implementing available leading-edge technologies and approaches. Policies will be required to ensure that efficiencies from improved vehicle technology are adopted and not erased by the purchase of more powerful and larger vehicles.
3. Owing to the rapid increase in GHG emissions from goods movement between the years 1990 and 2006, it will be significantly more challenging to meet the goods movement GHG reduction than to meet the smaller percentage reduction target for passenger travel.
4. Further research is required to establish specific targets for our region and the role that each possible policy measure can be expected to contribute, within the limits of our ability to predict behaviour and the mutually reinforcing effect of all measures.

16 Backgrounder: Truck Efficiency and GHG Reduction Opportunities in the Canadian Truck Fleet. Report of the Study Conducted by the Rocky Mountain Institute (RMI) for the Canadian Trucking Alliance (October 2007

17 Greene, DL and Schafer, A. 2003. Reducing Greenhouse Gas Emissions from U.S. Transportation. Pew Center of Global Climate Change.

18 Ibid.

Appendix G: List of Acronyms

AODA	*Accessibility for Ontarians with Disabilities Act*
BAU	Business-as-Usual
BRT	Bus Rapid Transit
CO	Carbon Monoxide
CO_2e	Carbon Dioxide Equivalent, an internationally recognized measure of greenhouse gases
EA	Environmental Assessment
GDP	Gross Domestic Product
GGH	Greater Golden Horseshoe
GHG	Greenhouse Gases
GPS	Global Positioning System
GTA	Greater Toronto Area
GTHA	Greater Toronto and Hamilton Area
HOV	High Occupancy Vehicle
ITS	Intelligent Transportation System
LEED	Leadership in Energy and Environmental Design
LRT	Light Rail Transit
Mt	Megatonne
MTO	(Ontario) Ministry of Transportation
NOx	Nitrogen Oxide
PHEV	Plug-In Hybrid Electric Vehicles
PM_{10}	Particulate Matter (Fine)
$PM_{2.5}$	Particulate Matter (Ultra- fine)
RTP	Regional Transportation Plan
SOx	Sulphur Oxide
SRT	Scarborough Rapid Transit
TDM	Transportation Demand Management
TMP	Transportation Master Plan
UGC	Urban Growth Centre
VKT	Vehicle-kilometres Travelled
VOC	Volatile Organic Compounds

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